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Forthcoming Event.

SEPTEMBER 8.

Institute of Metals:—Annual meeting in London. "Recent Developments in Non-Ferrous Metallurgy in the United States." Paper by W. M. Corse.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Jobbing Foundry Quotations.

We are constantly receiving complaints from foundry owners that the engineering buyers are offering such low prices for iron castings that there remains no profit for the foundry. On inquiry we invariably find that the foundries are still maintaining the ridiculous system of giving an overall price per cwt. or per pound for the particular type of casting *to be expected* from that buyer. In some cases the foundries have tried to improve conditions by submitting schedules of prices with lowered charges on heavier weights. They are then surprised when they receive a heavy bed plate with about 20 or 30 cores, which enters into the cheap grade category. The foundries have been ground down by engineers' buyers for generations and they are not getting—so far as jobbing foundries are concerned—a fair return for their efforts. Several have asked us to formulate conditions which would reverse these conditions. Combines, price rings, national associations apparently are the remedies they expect us to formulate. None of these do we believe to be necessary or desirable. We suggest that a few enterprising foundrymen should call a district meeting and send to every foundry concern a letter asking them whether they would agree in writing to refuse in every case to quote for any job on a weight basis, and that every figure quoted would take into consideration the moulding, coremaking and fettling costs for each individual casting. *It is not economic to lose money on a section of any one customer's orders*, even though the work surveyed as a whole is profitable. We have yet to learn that an engineer sells his machines at a price per cwt., and if it was not for shipping data, the average salesman would not know the weight of the articles he handles.

There would be no objection to founders giving an estimate of the weight of any job they were quoting for. There is a mistaken notion amongst some foundrymen that by heavy rapping of patterns they can increase profit by increasing the weight of the article. We doubt whether, if the extra time, energy and worry involved is analysed the procedure is profitable, and besides it is scarcely honest. We suggest a declaration stating that as a firm, they agreed to withdraw all quotations, price schedules, and not to renew contracts or arrangements based on a price per unit weight delivered. That, henceforth, every individual casting would be quoted for separately and that the price would be based upon the full production costs.

Once every individual casting is sold on its own real production cost, then the way would be paved for the institution of a standardised foundry costing system. This has largely been instituted in the Liege district, and it is interesting and disconcerting to note, that Belgian competition is being felt in southern iron foundries. Steel castings manufacturers are accustomed to it.

The effect of the imposition of this system would be that if a foundry was particularly well laid out for the economic production of any one type of casting, there would be a tendency for that type of casting to drift to them, and with quantity the unit cost should be lowered to the engineer. The selective placing of castings would help both the engineer and the foundry.

Strength of Cast Iron and its Thickness.

Mr. Willard Rother, writing in a recent issue of *The Iron Age*, describes an investigation, the purpose of which was to determine the relation between the physical characteristics of cast iron and the thickness of castings, for the guidance of the designing engineer and the protection of manufacturers. At the present time some engineers assume that if a certain cast iron has an ultimate strength of 25,000 lb. per sq. in., a section of 2 sq. in. in area should have a total strength of 50,000 lb., one 3 sq. in. in area 75,000 lb., etc. Unfortunately this is not correct, as the results of the following tests show. By increasing the thickness of a casting there is a considerable decrease in the ultimate strength expressed as pounds per square inch cross-sectional area.

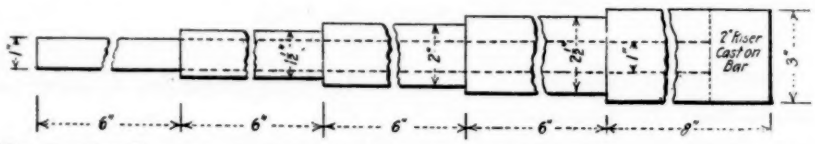


FIG. 1.—THE CASTING FROM WHICH THE TEST BARS WERE TAKEN SO THAT THE STRENGTH OF THE VARIOUS THICKNESSES COULD BE TESTED.

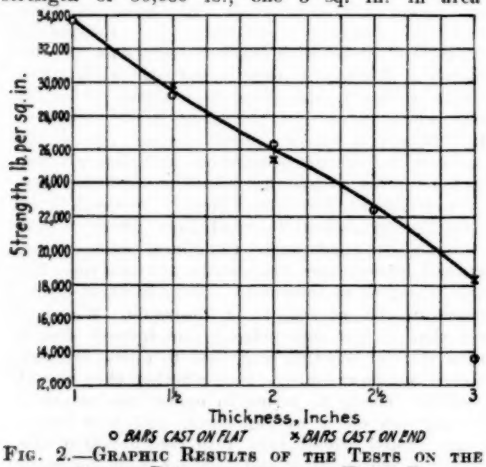


FIG. 2.—GRAPHIC RESULTS OF THE TESTS ON THE VARIOUS BARS AS GIVEN IN TABLE I.

On the other hand the foundryman often makes castings of varying thickness for which arbitration bars have to be furnished. These bars are of a standard thickness, poured from the same ladle as the casting, and are supposed to have the same physical characteristics. These bars are broken in the presence of an inspector and the castings are accepted or rejected on the basis of this test. Such tests are misleading because, if one of the castings should break subsequently and if a test bar were then to be taken from the casting itself, entirely different results would be obtained from tests with this bar compared with those from the arbitration bar. This often causes great losses to the manufacturer.

The controlling factor governing the strength of cast iron is the presence of graphitic carbon, or carbon in the free state. It is well known that the proportion of free and combined carbon varies with the thickness of the casting. A thin casting cools quickly and allows a considerable portion of the carbon to remain in the combined state, which gives a close-grained iron. The same iron poured in a heavier section cools much more slowly, permitting increasing quantities of carbon to change from the combined to the free state. In proportion to the time consumed in cooling, the metal becomes coarser and weaker.

Two problems, therefore, are to be solved, first to produce a test bar representative of a casting and secondly to determine the decrease in strength with increase in thickness of the casting.

To approximate, as closely as possible, conditions as they would exist in pouring a casting, test bars were made of different thickness, as shown in Fig. 1. Bars were made in one piece with five different diameters, 1, 1½, 2, 2½ and 3 in. respectively, each section being 6 in. long, except for a 2-in. riser at the end.

There were two sets of two bars each cast on end and two sets of two bars each cast flat, making four test bars each. They were cast in green sand, all from the same ladle of iron, which analysed 3.74 carbon; 1.35 silicon; 1.15 manganese; 0.075 sulphur; and 0.200 per cent. phosphorus.

The bars were left in the sand until the following morning, then machined to the proper size. They were taken from the centre, as shown in Fig. 1. The results are shown in Table I and plotted in Fig. 2. Hardness tests were made on the shoulders of one bar of each diameter.

TABLE I.—*Results of Tests on Experimental Bars.*

Test Bars Were 0.505 In. Dia., 0.2003 Sq. In. Cross Section

Thickness In.	Scelerescope Hardness.	Brinell Hardness.	Ultimate Strength, Lb. Per Sq. In. A	B	C	D	Average.	Decrease in Ultimate Strength, Per cent.
Test Bars Cast Flat.								
1	38	228	34,500	33,000	33,750	33,500	33,700	—
1½	34	179	30,000	27,500	29,500	30,000	29,250	13.2
2	32	179	26,250	26,000	26,500	26,500	26,300	22.0
2½	30	156	22,750	22,750	21,250	23,500	22,550	33.1
3	29	156	14,000	12,000	14,750	—	13,600	59.6
Test Bars Cast on End.								
1	—	—	30,750	29,500	30,000	—	30,100	—
1½	—	—	30,250	29,000	29,000	29,750	29,500	12.5*
2	—	—	25,750	24,750	25,500	25,750	25,450	24.5*
2½	—	—	23,000	22,750	22,250	23,000	22,750	32.5*
3	—	—	—	17,000	20,000	18,000	18,350	45.5*

* Compared to 1 in. bar, cast flat.

The graphic chart shows the average result for four bars each of the different sections cast on end and flat. The 1-in. bar cast on end showed very little more strength than the 1½-in. bar. This is caused by sand, cut from the corners of the mould by the flow of metal, lodging in this section. The 3-in. section cast on the flat was weak because of the riser placed directly over the centre of bar.

If the results of the 1-in. bar on end and the 3-in. bar cast flat are disregarded, a definite

TABLE II.—*Results of Test on Arbitration Bars.*

Arbitration bars were 1.25 in. dia., 1.227 sq. in. cross section.
Test bars were 0.505 in. dia., 0.2003 sq. in. cross section.

		A	B	C	D	Average.
Cast flat—	Transverse strength, lb. per sq. in.	4,350	4,050	4,420	4,150	4,240
	Transverse deflection	0.140	0.125	0.140	0.156	0.140
	Ultimate strength, lb. per sq. in.	31,500	34,250	32,500	32,750	32,750
Cast on end—	Transverse strength, lb. per sq. in.	3,790	4,325	4,000	3,900	4,005
	Transverse deflection	0.140	0.119	0.125	0.094	0.119
	Ultimate strength, lb. per sq. in.	34,250	33,750	33,500	34,000	33,900

relation is found to exist between the strength and the thickness. The line shows approximately 11 per cent. decrease in strength for each ½ in. increase in thickness.

For comparison four arbitration bars were cast on end and four cast flat with the same metal, and broken transversely on a 12-in. span. Tensile strength was determined with bars machined from the broken sections. The results are not included in the graphic chart, but will be found in Table II. The results of these tests check quite closely with those of the 1-in. bars.

This investigation shows conclusively the important influence the thickness of a casting has on its strength, and the desirability of arbitration bars which are actually representative of a casting. More work, however, is needed before a definite relationship can be established for use in engineering calculations.

Company News.

J. Grayson Lowood & Company, Limited.—The thirty-fourth annual meeting of the shareholders of J. Grayson Lowood & Company, Limited, was held on Friday last at Sheffield, the RIGHT HON. SIR SAMUEL ROBERTS, BART., in the chair. After the chairman had addressed the meeting, the directors' report and balance-sheet as presented were unanimously adopted. The two retiring directors, the Right Hon. Lord Stuart of Wortley and Mr. Cyrus Jones, were re-elected.

Consett Spanish Ore Company, Limited.—MR. MARK FENWICK, chairman, presided at the ordinary general meeting of the Consett Spanish Ore Company, Limited, at Newcastle. In moving the adoption of the report, he said the operations of the Orconera Company were prejudicially affected by a strike which broke out in the Bilbao district in July last year, and was continued for 11 weeks. There was no dispute with the Orconera Company itself, but the strike had a disastrous effect on the profits of the undertaking. When the miners of that company were fully employed, there would be a prospect of better results. As it was, they might consider themselves to have been lucky to have got anything at all last year. On July 23 the Obregon mines were restarted after a stoppage of three years and four months. These were now going on well. The output, it was hoped, would be up to what it was before the war. The alterations and improvements at San Salvador were nearly completed, and it was hoped to start these mines before the end of the year. They were well equipped for economical working. The directors intended to visit Spain in October to inspect the mines and plant. All that was required was better times and better prices.

Workman, Clark & Company, Limited.—Loss for year, £57,725; total debit, £2,238,965.

United Strip and Bar Mills, Limited.—Half-yearly dividend on preference, 8 per cent. per annum.

W. T. Henley's Telegraph Works Company, Limited.—Interim dividend, 1s. per share on ordinary, less tax.

Tyneside Electrical Development Company, Limited.—Interim dividend, 3 per cent. on preferred ordinary shares for half-year, less tax.

Swan, Hunter and Wigham Richardson, Limited.—Interim dividend, 3 per cent., less tax, on preference shares, and 3 per cent., free of tax, on ordinary.

Hayes Brothers & Carlsen, Limited, 15, West Bute Street, Cardiff.—Capital £5,000 in £1 shares. Scientific instrument makers. Directors: T. W. Pritchard (chairman and permanent), W. C. Payne and C. H. Carlsen.

International Processes, Limited.—Capital £7,000 in 6,000 preferred shares of £1 and 20,000 ordinary shares of 1s. each. Ironfounders, mechanical engineers, etc. Solicitors: H. Smith, Goss, King & Gregory, 62, London Wall, E.C.2.

Well Known American to Visit Europe.

Mr. V. E. Minich, a director of the American Foundrymen's Association, and president of the American Foundry Equipment Company, of 366, Madison Avenue, New York City, is expected to arrive in England in the course of a few days. Mr. Minich was one of the most popular of the visitors who attended the Paris Conference last September.

Catalogue Received.

Core Oils.—The Pneulec Machine Company, Limited, of Mafeking Road, Smethwick, near Birmingham, are circularising the trade with a four-page pamphlet describing their proprietary brands of core oil—Pneucol, Ventol and Lectol.

Publications Received.

Report on the Finance, Industry and Commerce of the United States of America, by J. Joyce Broderick, Commercial Counsellor, His Majesty's Embassy, Washington, D.C. Published by His Majesty's Stationery Office, Imperial House, Kingsway, London, W.C.2. Price 8s. 6d. net.

The booklet, which is issued by the Department of Overseas Trade, is extremely interesting for every person interested in the metallurgical and engineering trades of Great Britain. It will be remembered that under the Fordney Tariff, duty was added, imposed on ferro manganese, manganese ore, high speed, and many other commodities supplied from this country. As a result the tonnage of actual manganese imported has dropped from 469,109 in 1922 to 294,618 in 1923. The future supplies are causing some anxiety in the American steel industry at the present time, and a Committee of the American Mining and Metallurgical Society has recommended that home manganese ore be conserved and that the needs of the industry be met by importation. Slightly less pig-iron has been imported, but its value was higher. It seems, so far as iron and steel products generally are concerned the effect of the Fordney duties has been negligible. Unfortunately, however, no direct information is given as to its effect on the high-priced special steels such as high-speed steel. If it is included under the heading "Steel Ingots, Bars, etc.," it can only be a small portion, as the average value is only about £21 per ton.

Properties of Metal at High Temperatures.

A special electric crucible furnace was completed during the past month at the American Bureau of Standards. Four heats were made of nickel-chromium-iron alloys containing additions of cobalt, vanadium, tungsten, or molybdenum. The ingots produced are now being examined chemically and physically, and if sound and of the desired composition, test specimens will be prepared for high temperature mechanical tests.

Two series of tensile tests were made between 20 and 1,000 deg. C. on a steel containing 0.3 per cent. carbon, 20 per cent. chromium, and 1 per cent. copper, first water-quenched from 1,000 deg. C. or furnace-cooled from 870 deg. C. Somewhat higher proportional limits, elongations and reductions of area, but lower tensile strength values were obtained at all temperatures up to 500 deg. C. on the slowly cooled metal. These differences largely disappeared at higher temperatures.—*Iron Age.*

Mons. Ronceray Receives Decoration.

Monsieur E. V. Ronceray, the well-known French foundryman and director of Bonvillain et Ronceray of Choisy le Roi, has recently been created a Chevalier de la Legion d'Honneur by the Secretariat d'Etat de l'Enseignement Technique for services rendered to France—especially in connection with his work for the establishment of the new foundry high school in Paris. On behalf of the British foundry trades we offer Mons. Ronceray our congratulations.

Foundry Exhibition—1926.

Mr. F. W. Bridges, the well-known organiser of the Machinery and Shipbuilding Exhibitions, which are held biennially at Olympia, has decided to arrange a foundry exhibition at the Agricultural Hall, London, in the second week in June, 1926. Mr. Bridges is visiting Canada and North America this autumn, and will be present at the Milwaukee Exhibition, organised by the American Foundrymen's Association.

Maxims for Moulders.

Better a burn than a bad casting.—*Buchanan.*
Cast in haste, increase the waste.—*Buchanan.*

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

"Body" and Liquidity.

To the Editor of The Foundry Trade Journal.

Sir,—I have noted with much interest your leader and Mr. Victor Stobie's letter on the subjects of "Body" and "Liquidity."

I am afraid that my own personal experience does not allow me very closely to couple the two as Mr. Stobie does. Although I am very far from asserting that in *no* case is there any connection, such at the best can only be extremely partial. From my own experience, I have formed the opinion that the liquidity or viscosity of a steel may be affected by several different factors. Since in the main these factors would appear to depend upon the solutes of the ferrite, the presence or absence of dissolved nitrides would naturally be expected to play *some* part, but at the best this part can only be a very minor one. For the causes of increased viscosity we must, I think, look in an entirely different direction. The different natures of steels made from the same generic base by the various processes which Mr. Stobie enumerates—I omit basic Bessemer, except as producing raw material for some of the other processes—must, I think, be looked for in differences of steel refining "atmospheres," and transmissivity of containers and/or of slags. This latter is a subject on which I have done a considerable amount of intensive work during the last fifteen years.

> I attempted to particularise my conception of the meaning of the term body "as indicating that *inherent* property of an iron which causes its *ultimate product* to perform its service function repeatedly without deterioration, and renders *that product* less susceptible to the deleterious actions of many of those conventional poisons which undoubtedly, in other circumstances, would exercise very pronounced and well-proved ill-effects on it."

In formulating that definition I naturally left it to inference that the steps in fabrication of the "ultimate product" would be above suspicion as to further deterioration of it. Therefore I am unable to agree with Mr. Stobie in his penultimate paragraph. Furthermore, as in a previous article I have been at some pains to point out that in my view nitrogen only enters into combination with iron via a "cyanogen" or allied reaction, and that I had not found a shadow of indication that elementary molecular nitrogen could be the means of the nitrogenisation of iron, I would not raise the argument anticipated by your correspondent.

Your editorial comment on the injurious effects of refining under basic conditions with the "long arc" absolutely confirms my own experience and strengthens my deductions. True, where chemical conditions preclude the formation of cyanides or cyamamides—*e.g.*, on the acid-lined and acid-slag-covered electric hearth—high voltage is permissible and is utilised successfully in practice. But where the conditions are strongly and permanently basic, as in the case of the refining slag of the basic-lined electric furnace, the shortest possible arc should and does give the best results.

From the foregoing I do not wish you to conclude that I approach Mr. Stobie's criticisms in any antagonistic spirit. For his work I have a very great admiration; I welcome his interest, and I trust that many others will join in the discussion of a matter of the greatest possible import to those concerned with the problem of steel metallurgy.—Yours, etc.,

J. Kent Smith.

1, Staniforth Road, Attercliffe, Sheffield.
August 16, 1924.

[This letter agrees with our views that the connection between "body" and "liquidity" is apparently slight and occasional.]

To the Editor of The Foundry Trade Journal.

A few remarks arise out of your excellent editorial survey of the above subjects in your present issue.

Lest a mistaken impression might result from the summary you give of various theories for the above, I would point out that the item (*a*)therein should read (if it is based on the suggestion I put forward to you last week): "Lack of liquidity can be ascribed to (*a*) substantial absence of iron-oxide."

The use of high voltage in an electric furnace, if Mr. E. T. Moore's American report, to which you refer, is correct, will cause iron nitride to enter and spoil the "Body" of steel so made. I believe the highest phase voltage on any American basic lined electric furnace yet published is 250 volts. Several furnaces in this country, for which I am responsible, use 200 volts per phase. The voltage per arc is, therefore, in the two cases 125 and 100 respectively. I have, also, furnaces using no higher than 80 volts per arc. All these voltages vary with the impedance on load, but as the English furnaces of which I speak work on an average of 0.9 power factor, it is more than probable that the voltage drop of the American furnace I mention is greater than the others. Assuming, however, an equal percentage drop, the American highest voltage is 25 per cent. greater than the higher English voltage, which, in turn, is 25 per cent. higher than the lower English one. The higher English voltage should, on the basis of Mr. Moore's report, have a distinctly bad effect on the steel compared with the lower English voltage. Neither I nor others who have experience with both English voltages mentioned have detected the slightest difference in steels made under both voltages when made by equally experienced men. I do not see how the later use of a lower voltage in both cases for finishing the steel would rid the steel of any iron nitride which, it is suggested, had entered the steel: nor is it to be assumed, I submit, that the longer arc would keep out oxygen from the steel any more than the shorter arc. That the steel to which Mr. Moore refers was worse in "Body" than steel made under a low voltage could result from very many causes sometimes auxiliary to the use of very high voltage, such as the absorption by the steel of calcium from the lime of the slag. I have known 0.5 per cent. of calcium in hopelessly "stewed" electric steel!

A wrong conclusion from my previous letter figures in the second paragraph of your present editorial, perhaps the result of my trying to say much in too few words. The unslagged steel which was used for filling the header of the large casting was not increased in carbon, as suggested by you; it was taken as it was—just ready for slagging but with the addition of ferro-silicon. As the mould was filled slightly beyond the commencement of the header, it was considered undesirable to delay in any way the bringing up of the fresh steel, therefore the steel was not carburised in any way.

It is generally assumed that electric steel is usually hotter just before slagging than at any other time in its manufacture. This, I further submit, is wrong. It is certainly very fluid but, confirming my suggestion that such fluidity depends on the presence of iron oxide, it can at slagging time be rendered quite viscous by removing the contained iron oxide by an excess addition of ferro-silicon, notwithstanding that the generation of heat by the oxidation of the silicon will counterbalance the heat required to raise the alloy up to the heat of the bath. The excess silicon will, of course, alloy with the steel and cannot be counted a non-metallic inclusion; and silica is a very unusual inclusion unless combined with manganese, of which there is a dearth in a steel just ready for slagging.

In fine, may I point out in reference to your third paragraph that my suggestion is that the loss of the fluidity with which we are dealing is to be ascribed to the *absence* of iron oxide. This, other things being constant, agrees thoroughly with your statement that "stewed" steel shows a loss of fluidity.

Yours, etc.,

Victor Stobie.

Dunston-on-Tyne.

Last Tuesday the s.s. "Geraldine Mary," a single-screw cargo steamer built for the Anglo-Newfoundland Development Company, and specially designed for the carriage of paper in rolls, was launched from the Barrow-in-Furness Shipbuilding Yard of Vickers, Limited.

Dry Sand and Loam Moulding.*—III.

By A. Sutcliffe.

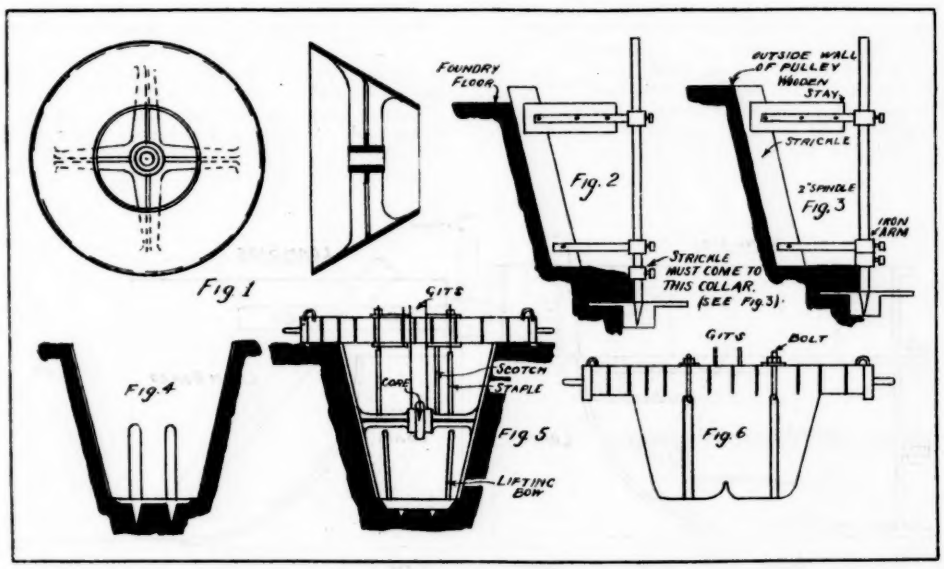
Making a Cone Pulley in Skin-dried Green Sand.

The tackle to be prepared for this job includes grids for lifting between the arms and a bottom plate to lift out the centre. The pulley illustrated (Fig. 1) is often made in loam, but seldom in a skin-dried mould with a backing of ordinary foundry floor sand. The author made smaller pulleys of this description in this way some years ago, and they were very good sound castings. This method was eventually tried with one of 6 ft. diameter, tapering to 2 ft. 4 in. and 4 ft. 9 in. deep, with corresponding saving, in view of the amount of tackle and room that would have been required for loam.

First a hole about 2 ft. sq. is dug in the foundry floor for the "dandy" plate. This hole is made 5 ft. 6 in. deep, and the sides are cut down to about 6 in. of the required diameter. The hole in the "dandy" is cleaned, and the spindle with arms and strickle attached is inserted, as shown in Fig. 2. The depth to which the strickle will work down is governed by the collar on the spindle bottom, and when it is brought down to that point in Fig. 5, leaving the bars within ¼ in. of the joint. The packing is scotched-up to the box bars and the grids are hooked up between the arms with hook bolts, as shown. The top is then filled with black sand and rammed up. It will be seen that there is not a gagger in the job.

After the completion of ramming, the nuts on the bolts are tightened up and the top lifted off and turned over for finishing, as shown in Fig. 6. After removing the arm pattern and any loose sand, the bottom of the core is lifted out on its plate, and stood on the three pins, when it is finished and wet blacked. The centre core is put in and the whole dropped on to the stove carriage for drying overnight.

A board is then put in the bottom of the mould so that the moulder can get in and remove the strips. The mould is then sprigged with 2-in. spriggs, just facing each of the four arms, to prevent the wash of the metal scabbing the outside. It is then given a good thick coat of wet blacking and trowelled, the marks afterwards being taken out with a little gum water.



the required diameter of the pulley at the floor level is obtained. After the sand has been cut and strickled to that diameter, fine facing sand is sieved in and rubbed on the face of the mould, the strickle being then run round again for the last time, completing the outside of the mould, as in Fig. 3.

The spindle and board are then removed, and the bottom lifting plate is bedded in just below the rim of the pulley (Fig. 4). This plate has a bevelled edge and 9-in. long pins to steady it into place. To assure the thickness of the metal for the rim ⅜-in. thick wedge-shaped strips, 2 in. wide at top and ¾ in. wide at bottom, are placed round, as shown in Fig. 4. Ramming is then commenced and carried up to the arms, the core being well ironed to support its taper. Since the arms will only fit in their proper place the moulder cannot go wrong. (It should be realised that the arms constitute the only pattern-making work required for the job.) The arms are set (see Fig. 5) and the joint made, facing sand being placed between, after which the grids are claywashed and rammed in, ironing again being carefully done. Packing is put on the grids, and also the two "gits" on the boss, as shown, and ramming continued to the top, the packing being carried up also.

The floor joint is then made round the outside of the pulley, and to save "gaggering" the top box, as the bars in the box stand short by 1 in., the outside edge of the box is dropped, as shown

To dry the job, three fires are put in—one at the bottom on bricks and the other two hanging in the mould from a bar across the top. The top box is put over for the night so that both can dry together. The next morning the top is lifted off and "logged up." The fires are lifted out, and all cinders and dirt removed from the mould. A rammer shaft is put down the taper holes in the bottom so that the pegs of the plate will not meet with any resistance, and then all is ready for assembling.

The bottom half of the core is then slung up and put into place, and the top part follows. To vent the rim a ¼-in. rod is put through it in the top part. The top part having been tried on and removed, it is put into place finally. In making up the runner a long runner-box that reaches to the edge of the moulding-box is used, which gives a cleaner job and is handier for the caster. If the top is not bolted down it should be well weighted. The weight of the job is about 16 cwt., and the moulding takes about 28 hours.

Making a Bell mouth Pipe in a Composite Mould.

This casting can be made much cheaper by employing a composite method than the whole job being made in loam under certain conditions.

First of all, there was available an old box with loose parts, 8 ft. 4 in. diameter, which exactly suited the requirements for a job of this character. The bottom box is levelled by putting the spindle dandy in the centre and covering the bars at the

* Part of a Paper read before the Burnley Section of the I.B.F.

bottom of the box with slabs of slate. It is then filled in with brickbats up to the joint of the first part of the box, after which the core of the job or the inside is built up. This done, the mould is taken into the stove, the spindle being kept in position until the mould is cast.

After its return from the stove next day the thickness piece was taken off the strickleboard, and the pattern required for the casting, minus flange, is struck up, this being put on after the top is lifted. Seeing the thickness of loam has not been put on the core to form the pattern, the job is returned to the stove again to dry for the last time.

Next morning the mould was ready for putting on the middle parts, and the moulder could commence to ram up with facing sand and grids until he reached the top of pattern. Here a joint had to be made, and the top was then rammed up, using eight or nine ¾-in. wood pegs for gates on the top edge of the pattern, so that the metal will flow down the thickness of the casting from the top.

After lifting off our top part the spindle is again required for putting on the flange at the top of casting. This is put on with a segment piece, shown in Fig. 7. The moulder can now lift off the middle parts, these having to be made good over-head and dried by bucket fires when finished. Returning to the bottom box, or the part of the mould made in loam, the moulder can strip off the loam which he put on for the pattern, leaving the body of the core underneath. This requires very little making good, and he is now ready for the return of the middle box.

The top box is returned, seeing that the flange cores give a good touch, so that they will not wash away with the flow of the metal.

If such a tank was made in five plates bolted together and caulked it would have cost less than half the foundry cost price. The bolts, of course, would have to be bought, and the cost of filling and caulking paid for, but it must be taken into consideration that, if such a tank made in loam happened to be broken in transit it would mean another complete casting being made, whereas if one of the five plates were to become smashed it

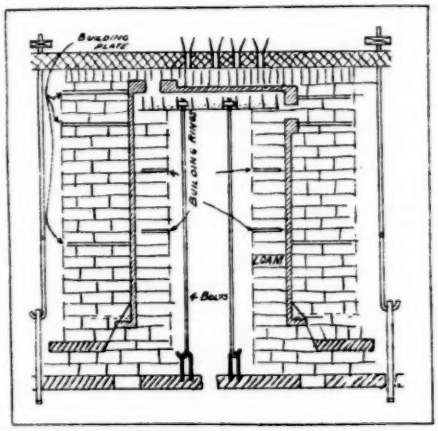


FIG. 8.—METHOD USED FOR MOULDING A TANK.

would only require replacing—a cost of about £5 instead of £45.

Taking into consideration the risk of this job being made in loam, and the time taken to make the job, it is obvious as to which is the better way

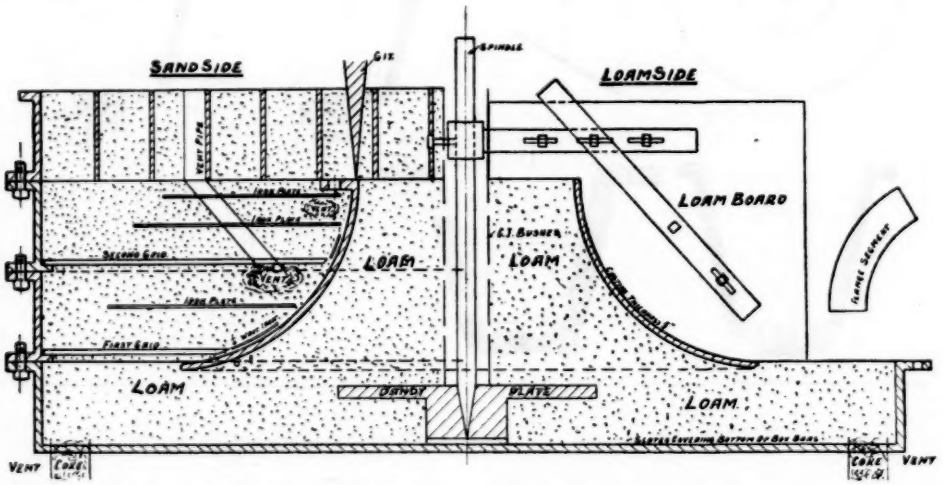


FIG. 7.—A COMPOSITE MOULD FOR MAKING A BELL-MOUTH PIPE.

The runners and risers are made up, making sure that all is cottered and clamped together, so that there will be no strain or "run-outs" when pouring the metal. The job is then quite ready for casting.

The job weighs 30 cwts., and takes about 35 hours moulding, no core-making and very little dressing, and this is thought to be the cheapest way of making this job.

Casting a Large Tank.

This tank (Fig. 8) was made in loam from a skeleton pattern. It was ¾ in. thick and weighed 42 cwts. 1 qr. 3 lbs. It required 146 hours to mould and 1 boy-hour for coremaking. The metal for plates required for building, weighed about 3 tons, the cost of melting has, of course, to be added to the above labour cost. The tank has to be made from hematite iron when using the loam method. It requires to be turned on to its side after having been cast in order to liberate the casting before its contraction takes place. It was found best to knock off all gits and risers before starting to strip, and to lift the mould from the pit in order to give adequate working space.

to make this tank, both for cheapness and satisfaction. The composition of the charge employed was:—

Metal used per cwt	C.	Si.	Mn.	P.	S.
15 Hematite	0.56	0.24	0.06	0.07	0.015
5 Scotch .. .	0.16	0.12	0.06	0.04	0.002
25 Sheepbridge ..	0.85	0.75	0.11	0.32	0.018
55 Scrap	1.87	1.10	0.27	0.66	0.066
Total ..	3.44	2.21	0.50	1.09	0.101

A Runner Top Plate made in Skin-dried Sand.

The weight of this casting (Fig. 9) was 4.25 tons. It was made from strickle boards and five loose flanges with prints on, one to form the centre boss and four for the outside bosses; also two oval core prints and three cores boxes.

The two oval cores had to be fastened in the two arm cores, one core for the centre boss, and eight arm cores, the strickle forming a dummy for the top of casting.

Working from a centre line, the moulder set the five bosses, rammed up the top, thus completing the top part of the casting. A hole was then prepared for the bottom board, which works on a spindle, but the centre lines must be conserved as they are required for setting the arm cores.

The strickling finished, and the job dry, the moulder placed boards—the thickness of metal—in the bottom of the mould, putting the arm cores on top of these boards, and setting them to centre lines and thickness pieces.

When all the cores are in their various places, the top must be put on, using three hooked bolts for each core, and screwing up these well through the grids to get a firm hold of the cores.

After ascertaining that all the cores are in place, that the top is complete with five gits on the boss, and that a riser is on each boss round the rim, the top can be lifted off.

The boards in the bottom can then be removed, after which the mould is ready for closing. Ample

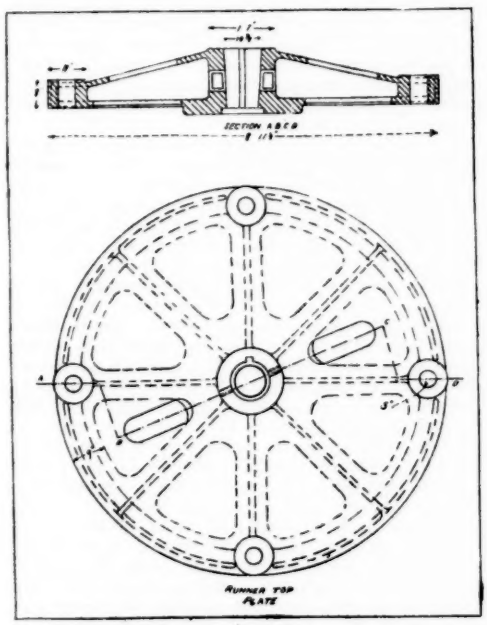


FIG. 9.—RUNNER TOP PLATE CASTING.

weight is required to hold down this job, and a good feeding is also necessary. The boss must then be bared by taking out the centre core.

Recently, when a casting similar to the one being dealt with—although it had been cast ten weeks—cracked when being bolted to the face plate in the lathe. It showed on analysis:—CC, 0.50; GC, 2.75; Si, 2.0; P, 1.00; Mn, 0.55; and S, 0.090 per cent. The charge was made up from 2 cwt. of a Yorkshire No. 3, 1½ cwt. of Scotch No. 3, 1½ cwt. hematite, and 5 cwt. scrap.

The sand used for skin-dried work was built up with 3 barrows red sand, 5 barrows black sand, 1 barrow road sand 2 buckets coal dust, and 3 buckets sea sand. It was damped with water and riddled without milling.

WEST'S GAS IMPROVEMENT COMPANY, LIMITED, Albion Ironworks, Miles Platting, Manchester, have received the contract for the new gas-making and coke-handling plant at the Blackpool Corporation gas-works at a cost of £68,000.

THE CLOSING of the Bolton works of H. Bessemer & Company, Limited, is only a sign of the times and an indication that the company propose to concentrate on the Sheffield works owing to the increased competition and cost of production. The works now closed are old-established, formerly belonging to the Bolton Iron and Steel Company, and were taken over by Bessemers in 1903. Thos. W. Ward, Limited, have acquired the works by arrangement with Messrs. Bessemer, and it is not likely the works will be run again. In all probability they will be dismantled and sold in various directions. Comprised in the plant are Siemens furnaces, steam hammers and forge equipment, rolling mills, locos, cranes, railway sidings, machine tools, axle and pattern-shop equipment, etc. It is to be regretted that Bolton is to lose this means of employment, but the site is a very valuable one, in a central position, and will no doubt be successfully used in future development of the town, whilst this latest venture of Thos. W. Ward, Limited, illustrates the enterprise of this progressive firm.

Application of Electric Power in German Industry.*

BY DR. CARL KÖTTGEN.

The first experiments on a large scale with the transmission of power by means of dynamo-electric machines were carried out in June, 1877, before officials of the Prussian Office of Mines, and at the end of 1877 the first power transmission plant was installed in an engineering workshop near Berlin. In the year 1881 the first electric railway was opened for public service, and in the year 1882 the first electric mine railway. After the great Electricity Exhibition at Frankfort-on-the-Maine, in the year 1891, at which the first large three-phase current plant was shown, the attempts to introduce electric power transmission received a great impetus.

The decade from 1895 to 1904, a period of economical prosperity, was characterised by great efforts to adapt the electric motor to the sometimes rather complicated working conditions of the various industries. The most difficult problem was offered by the large reversible drives which the mining industry required for the winding engines and the iron industry for the reversible rolling mills. The first winding engine with direct-coupled motors was installed in the year 1898, an eight-tub winding engine in the year 1901, and the first reversible rolling mill in the year 1907. When the problem of driving winding engines electrically was first taken up, two principles were followed: (1) A continuous-current drive with a very large starting and reversing apparatus for full capacity, and with a storage battery for the balancing of power; (2) a three-phase drive, with liquid starter, without any means of keeping the power fluctuations away from the primary station. Neither of these methods proved entirely satisfactory. The solution of the problem was only brought about by the Leonard controller with simultaneous application of a heavy flywheel for balancing the power (Ilgner system).

For the flywheels, which nowadays have a weight up to 65 tons, a special steel had to be used owing to the high circumferential speeds up to 145 m. (480 ft.) per second. In this manner the solution of the most difficult driving problem was found and the introduction of electric drive became quite general in the mining and iron industry. Parallel with these efforts to solve the problem, attempts were made to utilise better the material employed in the construction to render the drive and the plant less expensive. At the present time standard motors have perhaps one-fifth of the weight of those 30 years ago.

Present Position in Germany.

At the present time at least four-fifths of Germany are supplied with electric energy. All the larger towns and industrial districts possess public service networks. Almost all medium-sized, and certainly all the large industrial establishments, possess an electric power station of their own. In many cases the group drive is still considered satisfactory. The individual drive is making great strides, however. The standard motor is frequently considered to satisfy all requirements. Efforts are, however, being made more and more to adapt motors and starting and controlling apparatus, the latter frequently by automatic operation, to working conditions.

In iron and steel works the early adoption of the electric drive may not only be accounted for by the distances incidental to the course of the operations, but also by the early utilisation of blast-furnace gas, to a certain extent also of coke-oven gas and waste heat, which took place in Germany. The drive of continuous rolling mills was at first considered difficult, particularly as regards the shocks incidental to the various passes. But the first carefully-designed drive proved a complete success as early as 1897. The first electric drive of a reversing rolling mill also proved successful, and quickly spread. Here also steam engineering attempted to approach the electric drive in regard to consumption of energy, *i.e.*, heat units, but this also failed. The centralised heat-utilisation system maintains its superiority.

* Abstract of a Paper read before the First World Power Conference at the British Empire Exhibition.

Ferrous Alloys Resistant to Corrosion.*

By B. D. Saklatwalla.

Although it had long been recognised that certain percentages of chromium incorporated in steels rendered them non-corrosive, it was left to Harry Brearley, of Sheffield, England, to prove that the non-corrosive properties were dependent more or less on the hardening imparted by heat-treatment, and this discovery suggested to him the use of this material for cutlery. The first knives manufactured and hardened were found to be not only rust-resisting but also proof against discolourisation by contact with vinegar and fruit juices. This suggested to a cutler, Mr. Stuart, of Mosley's, who made these knives, the idea of calling them "stainless." This adjective has been carried along, but its true significance has not been realised. By "stainless" is understood the property of not discolouring, within a specified number of minutes, when a drop of a certain strength vinegar or an acidulated solution of copper sulphate or a similar solution is placed on the steel. The popular mind, however, has extended "stainless" to mean complete resistance to acids or atmospheric conditions, a condition that unfortunately is not realised.

A small amount of carbon exerts great influence on the properties of a chromium steel. Carbon in the presence of about 12 to 14 per cent. chromium has about three times the hardening effect of similar amount of carbon in a plain steel. The quenching and tempering temperatures must be higher than in the case of ordinary steel. The presence of chromium decreases the rate of carbide diffusion in a steel and it imparts the air-hardening properties of these steels and also their capability of retaining strength at high temperatures. By variation of the carbon content with different quenching and tempering temperatures, a very great variety of physical properties can be obtained with the same chromium content. This fact fortunately makes the high-chromium steels applicable to nearly all purposes for which steel can be used. The commercial grades with varying carbon and varying heat-treatment offer a range of from 25 to 90 tons per sq. in. tensile strength. Similarly the ductility and hardness can be varied to suit almost any engineering purpose.

The most generally known non-corrosive high-chromium steel is this so-called "stainless" steel used for cutlery purposes. It contains usually between 12 and 14 per cent. chromium and between 0.25 and 0.35 per cent. carbon. This composition is particularly adapted for cutlery purposes, and it is with this use in mind that the limits of chromium and carbon and chromium were chosen. This composition, however, has little bearing on non-corrosive steels for general engineering purposes. With the development of "rustless" metallurgy, it was found that by decreasing the carbon to less than 0.15 per cent., with the same chromium content, a metal is obtained that is much more resistant to corrosive influences, more ductile for general fabricating purposes, and also, especially in the low-carbon ranges, say, under 0.10 per cent., non-corrosive not only in the hardened but also in the annealed condition. Such steels are put on the market under the name of "stainless" or "rustless" iron. For resistance to oxidation at atmospheric and at higher temperatures, an increased chromium content seems to be beneficial. Steels with chromium content of 20 per cent. or higher show remarkable properties of non-scaling at high temperatures and of resisting fresh- and salt-water corrosion.

From the standpoint of the chemical engineer the plain high-chromium carbon steels with any percentages of chromium and carbon, hardened or annealed, are likely to prove a source of some disappointment. In spite of their ability to withstand oxidation and staining from food products, and in spite of the prevalent popular belief, they are not resistant to action of acids. Although in contact with fruit acids for a short period they do not discolour, yet submerged for long periods in fruit and other organic acids they lose considerable weight through solution, and in mineral acids, with the exception of nitric, they show very quick dissolution. In fact, such steels are more soluble in hydrochloric and sulphuric acids than plain carbon steels.

* Abstract of a Paper read before the American Chemical Society. The author is connected with the Vanadium Company of America.

Nickel Improves Acid Resistance.

In order to impart acid resistance to these steels, in addition to their property of withstanding oxidation, several other elements have been added. Nickel steels with about 25 per cent. nickel content have excellent resistance to mineral acids, but they are expensive and are not amenable to general fabrication. The addition of nickel to the high-chromium steels imparts acid resistance, but as this resistance does not obtain until the nickel content is high, from 5 to 20 per cent., such steels suffer from the same deficiencies as the plain high-nickel steels. The original Pasel steels made by Krupp, and Johnson's "Rezistal" made by the Crucible Steel Company of America are types of such steels.

Other elements which have been added to impart acid resistance are molybdenum and tungsten. These elements, while not necessary in excessive percentages, generally not over 2 to 3 per cent., on account of their high price make such steels too expensive for wide use. The earlier steels of Borchers and Monnartz were of this class.

Copper can be added to high-chromium steels, imparting to them, together with their ability of withstanding oxidation, excellent acid-resisting properties without the drawbacks of any of the above-described elements. The amount of copper necessary for this purpose is small, depending on the percentage of chromium, generally not exceeding 1.5 per cent. and in many cases not even 0.5 per cent. Such copper-chromium steels, especially in the low-carbon ranges (below 0.15 per cent. carbon), present very remarkable all-round non-corrosive properties. The acid resistance is obtained not only without sacrificing any of the oxidation-resisting properties, but with an actual increase in oxidation resistance. Also the copper-chromium steels are not as dependent on the state of hardening for their non-rusting and non-corrosive properties as the plain high-chromium steels. On account of the low price of copper and the small amount necessary, these steels seem to have a very promising industrial future.

The future of commercial development and wide engineering application of high-chromium steels undoubtedly lies with the low-carbon alloys, either those containing chromium alone or together with another element such as copper. The great hindrance, however, to the rapid progress of commercial expansion has been the high cost of production of such steels. At the prevailing prices of these steels they can enjoy only a very restricted field. This high cost is due to the necessity of using a high-grade low-carbon ferrochromium for the introduction of the chromium content. Since the advent of "rustless" and "stainless" steels, the price of such ferrochromium has been decreased to 9d. or 1s. per lb. of contained chromium, but when we consider that about 300 to 400 lb. of chromium is added for each ton of steel, the cost per ton runs up into figures that would make the steel thus produced incapable of ever competing with ordinary steel products, such as galvanised sheet or tinplate. However, within the last few years considerable metallurgical research work has been done, with the result that it is now commercially possible to produce on a large scale high-chromium steels without the use of the expensive ferrochromium. Chromium can be introduced into a bath of refined steel directly from chrome ore, reducing the chromium from the ore by means of silicon introduced into the melt. As chrome ore and ferrosilicon are both comparatively cheap and easily obtainable commodities, this direct process puts an entirely different commercial phase on the "rustless" industry. Chrome ore of a grade running about 50 per cent. Cr_2O_3 is worth approximately £4 per gross ton, so that the unit of chrome content can be obtained in steel at only a small fraction of the 9d. to 1s. which is the case when ferrochromium is used. Consequently such a process will enable the production of high-chromium steels at comparatively very low costs, insuring the wide and extended use which they justly deserve.—"Chemical and Metallurgical Engineering."

A Foundry Cost System.*

While the foundry cost accounting system outlined in this article has been arranged primarily for iron foundries producing castings of varied designs and of wide range in weight, the underlying principles upon which it is based can be rendered applicable to brass, malleable and steel foundries by changing the terminology and altering the arrangement of the cost details to suit the conditions prevailing therein.

To apply the principles of this system to brass, malleable and steel foundries, the more important special conditions prevailing in such foundries which will need be given treatment different from that recommended herein for iron foundries, are referred to later.

Determining the unit costs of castings by individual pattern numbers, and using them for crediting the foundry for good castings shipped therefrom and charging inventory or cost of sales, cannot be too strongly urged, for the reason that inaccuracies are bound to occur if castings of widely varying designs and weight range are grouped (at best, more or less arbitrarily) and costed at per pound rates.

Burden Methods.

The direct labour cost of castings—moulding, coremaking and cleaning—can be applied to costs of individual castings with reasonable accuracy, but the overhead expense portion of the total cost of output is not so easily dealt with.

The two methods most commonly used for the application of overhead in the foundry are "percentage-on-direct-labour" and the "rate-per-lb." methods. The basis of the former is the percentage relation of the normal total overhead expense to the normal total direct labour, the latter being the quotient resulting from dividing the normal total overhead expense by the normal total weight of output.

A careful analysis of foundry overhead expense has shown that a number of the items of expense are more closely related to the weight of castings produced, while others bear a closer relation to the direct labour cost element. Therefore, this system will give greater cost accuracy in foundries in which the conditions referred to in the opening paragraph obtain, for the reason that it takes cognisance of the inequity of applying the total foundry overhead expense on either of the two bases generally used—namely, direct labour or weight—by applying a portion of the overhead on each of these two bases, thus tending to reduce to a minimum the number of obviously inconsistent costs which result when the total overhead expense of the foundry is applied solely on one of these two bases.

If it should be desired to use the machine-hour-rate method for absorbing overhead expense, that method can be just as readily introduced under this system as under any other. However, where the machine-hour-rate method is adopted, it is recommended that a portion of the overhead expense be applied to the cost of castings upon the basis of weight.

There are two ways of employing this system for costing the month's output:—(*a*) Wait until the close of the month and determine the actual cost, or (*b*) cost the product as it is despatched throughout the month at predetermined costs; ascertain the actual cost after the close of the month and adjust the difference between the pre-determined and actual costs by charging or crediting cost of sales.

Obviously method (*a*) gives greater cost accuracy, but comparatively few concerns can wait until the close of the month for actual cost of product despatched throughout the month without seriously delaying the preparation and issuance of their statements showing the results of the preceding month's operations. Therefore, the latter method will be found of more practical application.

* Published by permission of the National (American) Association of Cost Accountants, of Bush Terminal Building, 130, West 42nd Street, New York. The N.A.C.A. has issued the following pamphlets on foundry costs:—1. Official Publication, Vol. I, No. 8, "Foundry Costs," by J. P. Jordan. 2. Official Publication, Vol. II, No. 3, "Cost Accounting for Brass and Bronze Foundries," by A. H. Barrett. 3. Official Publication, Vol. II, No. 5, "Managerial Uses of Foundry Costs," by J. P. Jordan.

Material and Labour Costs.

The cost of materials, etc., used and labour expended in producing castings are detailed under the following groups:—

Group (1), cost of metal at spout; (2) direct labour: (*a*) moulding, (*b*) coremaking, and (*c*) cleaning; (3) moulding overhead expense—direct labour basis; (4) moulding overhead expense—weight basis; (5) core shop overhead expense; and (6) cleaning department overhead expense.

Group 1.—Cost of Metal at Spout.

This item (A) should include the following:—

(1) Pig iron and scrap, including transportation; cost of unloading and piling; also cost of ferro-alloys.

(2) Fuel used in cupola, including transportation, cost of unloading.

(3) Cost of transporting metals and fuel from storage to charging-floor, and unloading them thereon; wages paid chargers and helpers, cupola crane and elevator men; also wages paid foremen.

(4) Fluxes and other miscellaneous supplies.

(5) Repairs and maintenance of cupola, charging-floor, cupola cranes and elevators, etc., including repairs and renewals of tools used in the melting department.

(6) Laboratory expense, including testing labour, supplies, repairs to laboratory equipment, etc.

(7) Portion of the following: (*a*) Insurance and taxes (basis, value of floor space and equipment used; (*b*) depreciation of buildings (basis, direct to buildings according to value and then to department according to floor space); (*c*) depreciation of equipment (basis, value of equipment); (*d*) maintenance of buildings and grounds (basis, direct to buildings and then according to floor space); (*e*) light, heat and power (basis, meter readings, or estimate by an engineer); (*f*) factory office salaries and expense, police, janitors, telephones and telegraph, liability and workmen's compensation insurance, etc. (basis, pay roll of shop employees); and (*g*) stores, operation and maintenance (basis, estimated by storekeeper).

The method of determining the cost per lb. of metal at the spout of the cupola (B) when gates, heads, sprues, splashings, drop and pigbed are actually weighed, and the actual melting loss is outlined below:—

The total cost of (A) items, minus the scrap value of gates, sprues, etc., divided by the total weight of output,* equals the average net cost per lb. of metal at spout.

The method of determining the cost per lb. of the metal at the spout of the cupola when gates, heads, etc., are not actually weighed, and an estimated percentage to cover melting loss used is as follows:—

(*a*) Determine the melting loss by a sufficient number of actual weight tests to give a good average. The actual weights used in these tests should include the weight of all metals put into the cupola, and the weight of metal poured therefrom; the latter is determined by weighing the ladle after it is lined, and before the metal is run into it, and again by weighing it after the metal has been skimmed.

(*b*) Deduct from the total weight of metals melted the melting loss percentage. The balance will be the total weight of metal poured.

(*c*) From the total weight of metal poured deduct the "Total Weight of Output."* The balance will be estimated total weight of gates, heads, sprues, splashings, drop and pig-bed.

(*d*) Value gates, heads, sprues, etc., at the rent market value of scrap in this form, less an amount sufficient to cover the cost of rendering this class of scrap suitable for recharging the cupola and credit this net value to the total cost of iron melted during the month. The balance will be the net cost of metal poured from the cupola during the month.

* Includes weight of foundry equipment (flasks, clamps, weights, arbors, gaggers, etc.) made in the foundry during the month, and defectives found before despatch from the foundry, but not gates, heads, sprues, etc.

(*e*) Dividing the net cost of iron poured from cupola during the month by the total weight of output gives the average net cost per lb. of iron, at which the iron content of each and every casting produced during the month shall be costed.

(*f*) Where method (*b*), described under the subheading "Burden Methods," is used for determining the cost of output an estimated rate per lb. for iron at the spout will necessarily have to be used. This rate shall be based upon the expected cost of the iron, scrap, fuel, etc., that will be consumed during the month for which this estimated cost is to be used.

Group 2.—Direct Labour.

(*A*) *Moulding Direct Labour (Moulders and Helpers)*:—

This figure is one of the following: (*a*) Piece price established as a basis of payment, or actual cost of moulding; (*b*) average cost of previous similar castings; and (*c*) foreman's estimate.

(*B*) *Core Direct Labour*:—

This figure is determined in the same manner as (*A*) above.

(*C*) *Cleaning Direct Labour*:—

This figure is arrived at by either of the following methods: (*a*) Use the piece-work price where the majority of patterns are covered by piece-work prices, and estimates for patterns not covered by such prices; and (*b*) when (*a*) is not practicable, determine the ratio of the total cleaning labour (other than the expense labour) to the total moulding and core-making labour, and apply this ratio to the direct moulding and core-making labour of each casting in order to obtain the cleaning direct labour.*

Group 3.

(*A*) *Moulding Overhead Expense, Direct Labour Basis.*

(1) Salaries of moulding foremen.

(2) Heat and light—Portion of: (Distributed to buildings according to floor space).

(3) Maintenance of buildings and grounds—Portion of: (Distributed to buildings and then to departments within buildings according to floor space).

(4) Insurance and taxes—Portion of: (Distributed to buildings upon the basis of value, and then to departments according to the proportionate floor space occupied. This applies only to buildings and such general equipment for which the maintenance cost is included in this group).

Workmen's compensation and liability insurance is distributed to departments upon the basis of the actual payroll in the same manner as the total premium is figured.

(5) Depreciation of buildings—Portion of: (Distributed to buildings upon the basis of value, and then to departments within buildings according to floor space).

(6) General expense—Portion of: (Distributed to departments upon the payroll basis. Salaries of superintendents and clerks, repairs and renewals of furniture, offices expenses, pro-rated charges from general books and other expense not elsewhere included).

(7) Salaries of clerks in moulding department.

(8) Defective castings. Losses on castings for *special* apparatus on specific customers' orders may be charged as part of the cost of such orders. When they occur in connection with *standard* production, they may be charged to the direct cost (if they can thus be allocated), or to overhead expenses if they cannot. When charged to overhead, such losses will be charged to either "Moulding overhead expense-direct labour basis," or to "core-shop overhead expense," depending upon the cause of the defect. This charge should include the total cost of castings less the scrap value, the latter being a charge to foundry scrap account. If the cost of defective castings is charged to overhead, the flat labour and material cost is used, *i.e.*, the total cost minus the overhead.

* The direct labour cost of such defective castings as are to be absorbed in overhead and non-durable foundry tools (such as flasks, weights, clamps, arbors, etc.) are not included under this caption, for the reason that they are to be treated as overhead expense, and the overhead is to be credited at scrap value.

Group 4.

(*B*) *Moulding Overhead Expense, Weight Basis.*

(1) Moulding expense materials: Sand, soapstone, sawdust, molasses, flour, pitch, plumbago, sea-coal, charcoal, coke (other than used in cupolas) oils, parting, blacking, gulac, gasoline, nails, chaplets etc.

(2) Operation and maintenance of handling equipment: Electric trucks industrial railway equipment, cranes, etc.

(3) Repairs, renewals and re-lining of ladles.

(4) Power used for cranes, sand cutters, moulding machines, etc. Determined by: (*a*) Permanent meterings or (*b*) temporary metering, or (*c*) H.P. ratings.

(5) Repairs and renewals of belting, shafting and pulleys.

(6) Wages of men unloading, handling, cutting and mixing sand. When practicable unloading may be charged into cost of sand.

(7) Portion of stores (*a*), and all despatch department expenses (*b*): (*a*) is determined by the value of materials other than coke, coal, sand and metal used in departments as shown by requisitions; (*b*) is determined by the weight basis.

(8) Insurance and taxes: Moulding machines and equipment—Portion of: Based upon valuation, except that in locations where machinery and personal property is not taxable, the real estate taxes should be distributed entirely on the valuation of buildings. (See Group 3 A—4.)

(9) Depreciation, moulding equipment—Portion of: (Based upon valuation.)

(10) Repairs and renewals of tools: Small hand tools, flasks, wheelbarrows, acetylene welding equipment, moulding machines and other equipment used in producing moulds.

(11) Repairs, depreciation and renewals of patterns. Special patterns which are likely to be used only for one job should be charged directly to the order. New standard patterns other than replacements may be set up as property and depreciated accordingly, or applied to cost of production as expenditures are incurred.

(12) Labour handling patterns and flasks to and from storage.

Group 5.

(*C*) *Core Shop Expense.*

(1) Expense materials: (Core sand, sea-coal, molasses, core and lubricating oil, core compound, flour, nails, iron rod, gaggers, arbors, etc.)

(2) Salaries of core-shop foremen.

(3) Wages of oven tenders and core pilers.

(4) Fuel for core ovens.

(5) Labour mixing and unloading core sand.

(6) General expense—Portion of: (Distributed to departments on payroll basis. See Group 3, A-6 for details).

(7) Maintenance of buildings and grounds—Portion of: (Distributed to buildings and then to departments within buildings according to floor space).

(8) Insurance and taxes—Portion of: (Distributed to buildings and then to departments within buildings according to floor space. If taxes are levied on machinery and equipment as well as on real estate, the valuation of the equipment used should also be taken into consideration. Workmen's Compensation and Liability Insurance is distributed to departments upon the basis of actual payroll in the same manner as the total premium is figured.)

(9) Depreciation—Portion of: (a) Buildings (distributed to buildings and then to departments according to floor space occupied within each building); (*b*) equipment (distributed according to valuation).

(10) Light, heat and power—Portion of: (*a*) Light and heat (distributed to buildings and then to floor space within each building); (*b*) power (distributed by: (1) Permanent metering, or (2) temporary metering, or (3) H.P. ratings).

(11) Operation and maintenance of cranes—Portion of.

(12) Repairs and renewals of tools, core boxes, etc. Special core boxes which are likely to be used only for the one job should be charged directly to the order. New standard core boxes other than replacements may be set up as pro-

perty and depreciated accordingly, or otherwise applied to the cost of production.

(13) Salaries of clerks in core room.

(14) Stores—Portion of.

(15) Defective castings resulting from defective cores: For description see Group 3, A-8.

Group 6.

(*D*) *Cleaning Expense*:

(1) Expense materials: Acids, sand-blast materials, lubricating oils, etc.

(2) Repairs and renewals to cleaning equipment, tumbling barrels, grinding wheels, pneumatic tools, brushes, knives, chisels, etc.

(3) Salaries chipping and cleaning foremen.

(4) General expenses—Portion of: (Distributed to departments upon the payroll basis. Salaries of superintendents and clerks, repairs and renewals of furniture, office expense, pro-rated charges from general books and other expenses not elsewhere included).

(5) Maintenance of buildings and grounds—Portion of: (Distributed to buildings and then to floor space within each building).

(6) Operation and maintenance of cranes.

(7) Light, heat and power—Portion of: (*a*) Light and heat (distributed to buildings and then to floor space within each building); (*b*) power (distributed by: (1) Permanent metering, or (2) temporary metering, or (3) H.P. rating).

(8) Insurance and taxes—Portion of: (Distributed in line with valuation of floor space and equipment used. (See Group 3, A-4.)).

(9) Depreciation—Portion of: (*a*) Buildings (distributed to buildings and then to floor space within each building); (*b*) equipment (distributed upon the basis of valuation).

(10) Stores—Portion of:

The application of overhead should be as follows:

(1) *Moulding Expense.*—(*a*) Direct Labour Basis.—(Applied on moulding labour only in the form of a percentage representing the relation of the normal total indirect expense included in Group 3 to the normal total direct moulding labour of a production centre or department.) (*b*) Weight Basis.—(Applied as a certain rate per pound based on the relation of the normal indirect manufacturing expense included in Group 4 to the normal weight of the production of a particular department.)

(2) *Core Expense.*—Applied on core labour only in the form of a percentage representing the relation of the normal total indirect expense included in Group 5 to the normal total direct core labour of a production centre or department.

(3) *Cleaning Expense.*—Apply on direct cleaning labour. If, however, the direct cleaning labour applicable to individual orders or classes of castings cannot be ascertained, this expense together with direct cleaning labour may be distributed as an element of the moulding overhead expense upon the direct labour basis.

Brass Foundries.

The more important special conditions, referred to in the opening paragraph, obtaining in brass, malleable and steel foundries requiring different treatment than that recommended in the foregoing for iron foundries, are outlined under the next three main headings. (1) In determining the cost of each different mixture, or alloy, proper allowance should be made for the variation in the life of crucibles (if used) and quantity of fuel consumed per lb. of alloy melted. These vary considerably for the different alloys. Obviously, securing the correct weight of castings cannot be too strongly emphasised; (2) Sprues, heads, gates, etc., from each alloy should be actually weighed and recorded for two important reasons—1st, that the correct melting loss can be determined; and 2nd, so that the scrap from the different alloys can be correctly valued.

Malleable Foundries.

(1) Since the annealing of malleable castings is a rather lengthy process, the accounting for the month's production in that month's business may in some cases be impractical. This is true also for the "hard" and "soft" cleaning costs, the former preceding and the latter following the annealing process. Under such conditions the use of predetermined rates for these operations will be necessary. (2) The most practicable way to incorporate the cost of these special operations in the cost of castings is to determine average costs (per unit of direct labour cost, or per lb. of rough casting weight, as the case may be) based upon the quantity and cost of good castings which have passed through these operations during the month.

Steel Foundries.

(1) As the annealing of steel castings involves conditions similar to the annealing of malleable castings, the same accounting procedure should be followed in both cases.

(2) If method "C" is used for determining the cost of metal at the spout, the actual weight of metal poured will be determined by weighing the ladle after the metal is run into it, and again weighing it after the metal has been poured but before the slag is removed.

Monthly Statements.

Monthly cost and factory expense statements, showing information that will be an aid toward more efficient foundry management are desirable.

The cost statement should be compiled in such form as to show the average cost per lb. of good castings produced, for each of the six (6) groups provided in the foregoing descriptions, with as many sub-divisions under each group as may be deemed useful by the management.

The factory expense statement would show the total overhead expenses of the foundry (with a separate statement for the pattern shop) detailed to classes of expense to whatever extent desired.

The following definitions of terms, descriptions of use, etc., will prove useful in connection with the compilation of a monthly cost statement.

(*A*) *Weight Output—Gross and Net.*—(1) Gross output is the total weight of metal poured less the weight of heads, gates, sprues, splashings and pig-bed or drop. The only use made of this figure on the cost statement is for determining the average cost per lb. of metal at the spout: (2) net output is the weight of good saleable castings poured during the calendar month, i.e., it does not include the weight of defectives found before despatch, nor the weight of foundry equipment made in the foundry. This weight is used as a divisor for all items of cost, other than metal, and is shown on the cost statement for determining the average cost per lb. to be shown opposite the various classes or departments.

(*B*) *Direct Labour.*—(1) From the pay roll distribution the total direct labour for moulding, core-making and cleaning for the month is determined: (2) to these totals should be added the direct labour cost of unfinished work carried forward from the preceding month: and (3) from these totals deductions should be made for the flat labour cost of the following: (*a*) Defectives found before shipment from foundry; (*b*) foundry equipment: (*c*) unfinished work at end of month.

(C) Metal Cost.

The net cost of iron in gross output should be lessened by the actual cost of metal poured into foundry equipment (flasks, arbors, clamps, weights, etc.) during the month and into defectives found before shipment from the foundry as the net cost of both of these will be included in the overhead expenses.

(D) Overhead Expenses.

As in the case of "Direct Labour" above, the total expenses for the current month should be modified by the amounts applied to unfinished work at the beginning and end of the month in order to arrive at the correct amount of this cost item applicable to the current month's production.

(E) Castings Despatched.

(1) The weight and value to appear under the caption should represent the total deliveries for the calendar month, including any castings made in prior months but not despatched until the current month; (2) it should be especially noted that the total deliveries that will appear on the cost statement may not be (in fact, rarely are) the same as

the total shipments used in determining the monthly adjustment, because the former will almost invariably include castings made in a previous month on which the adjustments will have been made in prior months.

(F) Monthly Adjustments.

If the foundry output is valued at predetermined costs as shipped throughout the month, monthly adjustments are desirable. By securing an inventory of unshipped foundry product on hand at the end of the month and valuing it at the approximate costs at which it will be priced when shipped from the foundry, such an adjustment is readily determined.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Judging and Mixing of Pig-Iron.

To the Editor of The Foundry Trade Journal.

Sir,—Mr. Young's Paper on the above and the subsequent criticism have been very interesting, and I note he is perfectly willing to debate the question on any platform. It is, however, difficult to see what useful purpose this will serve simply because Mr. Young will not accept the ordinary *commercial* analyses of pig-irons and cast irons.

Having failed by argument and having consistently also failed to give *proofs* of the correctness of his views, to fall back on his last and weakest line of defence by affirming that the reason he cannot give proof is that the analyses themselves are never correctly given, is to give his whole case away.

One cannot forget that in the winter of 1918-1919 he distinctly stated that the difference of 800 lbs. in transverse strength on two sets of bars of similar analyses could not be explained on chemical grounds, nor can one forget Mr. Young's statement in discussing a recent Paper that in the foundry he controls he has 17 different mixtures. These 17 different mixtures seem easily to explain the difference between the opinions of Mr. Young and those who do not accept his views. To have 17 mixtures in an iron foundry Mr. Young will not deny that he has several different kinds *and qualities* of pig-iron, some of which will have been made under totally different conditions such as will produce certain physical properties because of their different methods of manufacture. Hence it will be seen that Mr. Young is unwittingly working on fracture as well as chemical composition, which is the whole case of the physicist.

Therefore, if Mr. Young will admit this one fact there will be no difference of opinion in principle between him and his critics, hence no need for a full dress debate. Yours, etc., E. Adamson.

18, York Street, Sheffield.
August 8, 1924.

To the Editor of The Foundry Trade Journal.

Sir,—At the recent Foundry Exhibition Mr. H. J. Young lent himself to a startling condemnation of the puerile efforts of small laboratory staffs to combat the problems of accurate analysis and scientific mixing. Having been instrumental as a works chemist in sending many cylinders from the Midlands to Tyneside, although aided only by a small staff, I naturally was much interested in his remarks.

Bearing the above in mind, I have, however, been far more interested and amused by reading in your issue this week that out of some thousands of test-bars analysed by Mr. Young's staff there are only isolated cases of agreement in analysis. It is well known with what exactitude Mr. Young chooses his pig-irons and conducts his mixing and melting; it may also be assumed that he frequently uses a mixture for several days in succession, and I therefore make bold to suggest that his test-bars often contain the same components in the same proportions, but that the insuperable difficulties which he asserts render futile the analytical efforts of small laboratories have even presumed to present themselves to himself and staff—and have conquered. Has this occurred to Mr. Young? Physician—heal thyself!—Yours, etc., H. Field.

Willenhall,
August 16, 1924.

Progress of the Sand Slinger.

Writing under the heading of "Movable Moulding Machine for Large Work," a recent issue of the "Iron Age" discusses the economies effected by the introduction of the sand slinger moulding machine into the foundries of the Marion Steam Shovel Company, Marion, Ohio, U.S.A. It is interesting to note that this company have recently established offices in London, and intend entering the European market for this type of machine, either by manufacturing in Great Britain or by importing. In this class of machinery a large number of both manganese and plain carbon steel castings are incorporated, and it is in the steel foundry where the sand slinger has been introduced.

The machine is stated to be the largest of its kind so far made, and is used for the cutting of sands and the ramming of moulds for frame castings and other parts of the steam shovels. It is of the locomotive type, and operates on an 8 ft. 8 in. gauge track 160 ft. long. It is used to ram flasks as small as 20 in. dia. and 10 in. deep, and as large as is necessary to mould castings 12 to 14 tons each. The rammer head has a reach for ramming moulds up to 10 ft. wide. Moulds of any length can be rammed to a depth of 13 ft. in the case of pit work and from 5 to 6 ft. in height above the foundry floor. For the operation of the machine two men suffice, one operating the machine itself while the second does the ramming.

The system employed is to use the night gang to shake out over the back of the machine the moulds made during the day. The castings and a large part of the gaggers are removed. They also set up the flasks at the side of the track and place the patterns in position, leaving the boxes ready for ramming in the morning.

An hour before the moulders start work the machine is placed in operation to cut and riddle sand for the day's work. A screw-feed and bucket elevator raises the sand from the track, then discharging the sand into an oscillating riddle over a 10-ton storage hopper. The gaggers are discharged into hoppers at the side of the machine. The bottom of the hopper is left open during this sand preparation so that the sand may fall through the hopper into the centre of the track, where it is deposited in a heap 30 in. high. The sand is then tempered. As it is needed for moulding it is again cut and riddled, but this time it is retained in the hopper, from which it is fed to the rammer head and discharged into the flasks at high velocity. The machine is operated until the hopper is empty, when the ramming is stopped for reloading. The reloading time of the hopper, which has a capacity of 10 tons, is said to be three minutes.

Power is supplied for the various operations by four motors—one for machine travel on the track and for operating the elevator conveying sand from the floor to the riddle; one operates the buckets which carry the sand from the hopper to the rammer-head and rotates the hopper; one raises and lowers the rammer-head; and the fourth operates the rammer.

Economies Shown.

It is stated that a mould that formerly took a moulder and labourer four hours to ram with a pneumatic rammer is now rammed in the machine in ten to fifteen minutes. Eight moulds for side-frame castings may now be completed in 10 hours as compared with four frames in 24 hours by a moulder and labourer using the old method. A mould for a lower-frame casting which formerly required 24 hours, and for which 36 hours of time was paid, is completed in 10 hours with the use of the machine. The sand slinger was manufactured by the Beardsley & Piper Company, of Chicago. In Great Britain it is the Foundry Plant and Machinery, Limited, of 100, Wellington Street, Glasgow, that manufactures the sand slinger.

Petters, Limited, Yeovil, have been awarded the silver medal of the Staffordshire Agricultural Society for their cold-starting Petter S-type oil engine. This engine last year received the silver medal of the Royal Agricultural Society of England.

Electro-Metallurgy in Italy.*

BY DR. F. GIOLITTI.

There is no country in which the problems dealing with the iron industry are so intimately pervaded by both the economical and political character as in Italy. It is beyond the scope of this Paper—and lack of space would forbid it—to analyse the reasons for this fact. Suffice it to mention some of the most important and evident of such causes; on the one hand, the scarcity, the nature, and conditions of the deposits of iron ores in Italy, deficiency of fuels, the entire absence of coal suitable for the production of the typical reducer, *i.e.*, metallurgical coke, which is used abroad, almost without exception, in reducing iron ores. On the other hand, we may mention the rapid development of the Italian iron-products-consuming industries and the vast and pressing technical requirements which are also steadily increasing and are connected with the military defence of a nation which is rapidly developing and is actually almost as populous and powerful as many of the nations that possess rich iron ores and coal deposits within their boundaries.

During the period 1897-1913 (*i.e.*, up to the last normal year before the European war broke out) the increase in the Italian output of the two fundamental products of an iron industry was as follows:—

TABLE I.—*Production.*

	1897	1900	1906	1913
	Metric tons.	Metric tons.	Metric tons.	Metric tons.
Pig-iron ..	8,393	33,000	135,000	427,000
Steel ingots ..	63,940	116,000	332,920	933,500

Whereas during the same period the imports of these two products varied as shown in the following table, the data of which (added to the corresponding figures given in the preceding table) confirm the considerable increase of the inland consumption of iron products:—

TABLE II.—*Imports.*

	1897	1900	1906	1913
	Metric tons.	Metric tons.	Metric tons.	Metric tons.
Pig-iron ..	156,000	160,000	169,000	222,000
Semi-finished & finished steel	99,000	146,000	265,000	253,000

The next table contains the data for 1914-22, corresponding to those shown in Tables I and II:—

TABLE III.—*Production and Imports.*

	Pig-iron.		Steel	
	Output.	Imports.	Output.	Imports.
	Metric tons.	Metric tons.	Metric tons.	Metric tons.
1914	385,000	237,000	911,000	244,000
1915	378,000	247,000	1,009,000	226,000
1916	467,000	306,000	1,269,000	317,000
1917	471,000	320,000	1,331,000	792,000
1918	313,000	120,000	992,000	657,000
1919	239,000	223,000	732,000	465,000
1920	88,000	170,000	773,000	377,000
1921	61,000	76,000	700,000	224,000
1922	91,000	—	943,000	—

The foregoing figures may be sufficient to give a rough idea of the exceptional progress made by the Italian iron and steel industry from the origin of the electric manufacture of iron to its actual firm industrial stage. An examination of the tables shows that during the period in which the electric furnace was applied on a vast scale to the manufacture of steel (this application made tremendous progress during the war and it subsequently extended further in Italy owing to the abnormal economic and industrial conditions prevailing after the war) the Italian iron and steel industry traversed a period of a comparatively rapid development which was characterised by the erection of numerous modern plants, the total capacity of which exceeds by far the output that may be actually reached, the latter being considerably limited by the difficulty in the supply of some raw materials (pig-iron, steel, scrap, etc.), and by the difficulty of meeting—so far as some products are concerned—the competition of the corresponding foreign materials which are manufactured under more favourable conditions.

The electric manufacture of pig-iron which, although having certainly great importance for the future, cannot be stated to have attained hitherto such a technical degree of improvement as to be compared with that of electric steel. During the year 1914 the Italian output of electric steel was very small, amounting to a few thousand tons only. In 1919 it amounted to 93,800 metric tons and to 158,000 tons in 1922. The number of electric furnaces for steel manufacture rose similarly from 12 in 1914 to 178 in 1922. All special steels and nearly all steel castings manufactured in Italy are actually produced by the electric furnace. All converters and all crucible melting furnaces for steel manufacturing have been dismantled or remain inactive. A large number of electric furnaces of large capacity (there are actually about 120 of them, most of which were erected during the war) are working, in addition to the Siemens open-hearth furnaces, either for the production of common carbon steels (for shapes, plates, forgings, castings, etc.) or for the production of middle-grade steel (for weldable plates, pipings, etc.). The total capacity of the electric furnaces for steel manufacture actually existing in Italy may be estimated at about 800,000 tons a year.

Regarding the electric manufacture of pig-iron, the author points out that this had its origin and will presumably develop in Italy. The statistical data of the Italian iron products during recent years show a considerable production of electric pig-iron. Thus it amounted to 56,000 metric tons during 1917 and to 62,000 tons during 1918; subsequently, however, it dropped rapidly. This production was exclusive of so called synthetic pig-iron, which is prepared by smelting and carburising steel turnings in the electric furnace. This manufacture had quite an exceptional character, and was only possible and profitable owing to the abnormal conditions due to the war, namely, an enormous supply of steel turnings, high cost of pig-iron, scarcity of coal, etc. As soon as such conditions disappeared, that manufacture ceased almost entirely, and the furnaces which were used for that purpose were in some cases taken out of operation and in other cases employed in the manufacture of ferro-alloys.

In conclusion, the author refers to the electric manufacture of ferro-alloys, the production of which, he states, amounted in 1913 to 4,700 metric tons, in 1920 to 20,881 tons, to 15,400 tons during 1921, and to 20,203 tons during 1922. The ferro-alloys that were manufactured to the largest amount were ferro-manganese and ferro-silicon of the various grades commonly used.

* From a Paper read before the First World Power Conference at the British Empire Exhibition.

MR. A. FLEMING BROWNE, 11, Carteret Street, Queen Anne's Gate, S.W.1, has been appointed London representative for W. Sisson & Company, Limited, engineers, Elmbridge Road, Gloucester.

MR. G. M. STEVENSON, 56, Sandford Road, Moseley, Birmingham, lately Birmingham representative of T. W. Broadbent, Limited, Huddersfield, has established himself in business as an electrical contractor.

IN HIS presidential address at the triennial conference of the International Federation of Metal Workers, held in Vienna, Mr. Thomas McKenna, of Middlesbrough, general secretary of the National Union of Blast-furnacemen, Ore Miners, Coke Workers, and Kindred Trades, said there could be no greater danger to the welfare of the metal workers of Great Britain and elsewhere than the increasing of the working hours in Germany, and the cheap production there. They would ultimately suffer by the infliction of a low standard of life on the workers of Germany. The recent happenings in Germany, by which the hours of labour had been increased to 57 and 59 per week, for wages which were between 40 and 50 per cent. less than those paid in Great Britain, constituted a peril of the greatest magnitude, not only to the workers in the metal industry, but to the life of the industry itself in Great Britain. This peril must be removed. If this could not be accomplished by the German metal workers themselves, if not by the strength of that federation, then by the power of the British National Labour Party and the sympathetic public opinion of this country.

Casting Zinc Alloys.

By "Celsian."

Amongst the many metals used for the production of castings one variety which is attracting much attention nowadays as a cheap substitute for brass and gunmetal are the alloys of zinc. The simplicity with which they can be prepared in ordinary kettles or iron pans is largely responsible for the favour they find in small foundries. Another advantage is that the preparation of these alloys does not require any very great experience in the metallurgy of the metals employed, and also the mixing or blending is a comparatively simple matter.

Amongst the disadvantages possessed by the alloys of zinc is the lack of softness or pliability. They greatly resemble cast iron, due to the fact that they break under impact, although stronger than the latter in many ways. From the nature of zinc it is not possible for it to form ductile alloys, so that all additions of other metals are merely made to increase their strength and hardness.

The strength of zinc itself is not great, as the crystals of the metal are large, which usually denotes weakness. By adding metals which will break up these crystals to much smaller ones a much stronger metal will be produced. Although copper reduces the size of the crystals, the strength is not greatly increased, but if aluminium is also added, the resulting alloy will possess a high tensile strength.

The casting troubles are associated with the weakness produced by using old cast metal, wasters, gates, risers, etc. The cause of this is that all zinc and aluminium alloys, on remelting, show a great increase in the amount of oxide inclusions, and therefore slaggy castings are the result.

Incidentally, an increase in the amount of zinc oxide and aluminium oxide means an increase in the loss on remelting. All old scrap, borings, etc., should be remelted with fluxes and cast into ingots, whereby the large bulk of the oxide will be removed by skimming. The refined ingots can then be used for making the castings. Various fluxes are used for the refining, but the most common one is ordinary zinc chloride.

It has been stated that grease and other carbonaceous dirt will be the cause of porous castings, but this should not be so if the metal has been melted under the proper conditions.

Making the Preliminary Alloy.

The first step consists of preparing a preliminary alloy of copper and aluminium, and then mixing it with several times its weight of zinc. The work is conducted in a small plumbago crucible heated in a pit fire. An analysis is taken of the preliminary alloy which may contain, say, 20 per cent. of copper and 15 per cent. of aluminium. The metal is poured into ingot moulds and stored for the future production of numerous zinc alloys.

This method of working is much more satisfactory, as the preliminary alloy is capable of being used for various purposes, and also less zinc is burnt off. The metal must be free from lead, otherwise segregation will occur when the casting cools. A maximum of 1.5 per cent. lead and 0.5 per cent. iron is usually fixed. Regarding the kettles or pans used for the melting, it might be added that very few founders use sufficient care in judging or selecting the metal which these appliances are made of. The surface of the pot should be as smooth as possible, otherwise there will be a risk of the zinc being contaminated with occluded iron. The surface of the molten metal should be completely protected from the direct action of the flames of the fire.

As iron is capable of producing detrimental effects on the castings of zinc alloys, every precaution must be taken to prevent this impurity being present. The iron of the kettle or melting pot should have a high percentage of carbon, and as low a percentage of silicon and phosphorus as possible. If the alloy does not require to be heated to too high a degree, it will be given less opportunity to combine with the iron. The layer of crust which is formed after several charges have been melted will protect the alloy from the intrusion of iron to a large extent.

To prepare an alloy of any desired composition, the preliminary alloy is weighed out and melted first, after which bars of zinc are added in the required proportion.

Casting.

Cast-iron moulds are generally preferred for this class of work. These moulds are heated prior to pouring the metal, as it gives the casting more time to cool uniformly. This heating of the moulds should not be sufficient to cause the molten alloy to cool slowly, as this would mean that coarse crystals would be formed which are much weaker. The alloy in the melting pot, which is covered with a layer of grease, tallow or cheap oil, to prevent oxidation, is poured into the mould at as low a temperature as possible within limits. This results in the cast alloy possessing a finely crystalline structure, and if the cooling has taken place rapidly, the tensile strength will be increased. In casting, the mould should be turned on one side as far as is practicable, so that the molten metal flows against the walls of the moulds, allowing the air to escape. The best results are secured by pouring continuously until the mould has been filled, thus preventing the formation of oxide films. The most satisfactory castings will be secured where the molten metal has not to re-enter sharp or deep angles, and also where there is no constriction of the flow.

Generally speaking, the casting of zinc and its alloys requires more practical experience than is necessary for that of almost any other metal, excepting aluminium, and very little assistance is to be gained from foundry books on this work.

Australian Iron and Steel Bounties.

A statement under the Iron and Steel Products Bounty Act has been issued by the Australian Minister for Customs. The statement relates to the use of imported materials in the manufacture of products upon which bounty may be paid. Extracts from the Act are appended :—

"(1) No bounty shall be authorised to be paid under this Act on any article named in this section manufactured or supplied or to be manufactured or supplied under a contract containing a term or condition permitting or providing for the deduction of the amount of the bounty or any part thereof from the price or moneys payable for the article.

"(2) No bounty shall be authorised to be paid under this Act on fencing wire, galvanised sheets, traction engines, or wire netting unless those goods are manufactured from materials produced and manufactured in Australia.

"Provided that in the event of such circumstances arising as would, in the opinion of the Minister, after inquiry and report by the Tariff Board, warrant the use of material, other than that produced and manufactured in Australia, for the manufacture in Australia of any goods on the manufacture of which a bounty is payable under this Act, the Minister may authorise that material to be so used, and the goods on which bounty is payable made from that imported material, or partly from Australian material and partly from such imported material, shall not be excluded from the payment of bounty under this Act by reason of the use or part use of that imported material."

The Tariff Board recently decided that magnetos, roller and ball bearings, and steel channels might be imported for the manufacture of motor tractors on which bounty is paid.

Canadian Steel Production.—Despite the claims made from time to time that Canada could develop its steel industry to a point where the Dominion would rank second to the United States as a producer, the steel output has declined to a level below that before the war. In 1913 Canada produced 1,044,000 tons of steel; by 1918 production rose to 1,873,000 tons, but since that year there has been a steady decline, until 1923, when the output amounted to 884,000 tons only. In the first three months of the current year production of steel amounted to only 207,000 tons. This record was established despite the claims made during the war that the industry would be developed to a point of 10,000,000 tons capacity. Steps are under way at the present time, however, to revive steel-making in Canada. Interests associated with the industry recently called attention to the ore and coal reserves of the Dominion, the extensive and extending consumption of steel products and the possibilities of Canada becoming an exporter of steel products.

The Metallurgy of Aluminium—I.

By F. A. Livermore.

Occurrence.

Aluminium is one of the most widely distributed and scattered metals; it is not found in the metallic state (although Stocker* has stated erroneously that aluminium occurred as shining scales in an alumina formation at St. Austell, near Cornwall. It occurs in a variety of forms as oxide, but more generally in combination with other metals, such as zinc, iron, magnesium, etc., forming aluminates, the combination with bases in the form of felspar, mica and quartz are especially numerous, other compounds existing such as gneiss, porphyry, eurite, trachyle, etc. Perhaps mention should be made of the gradual decomposition of these aluminous compounds by the action of water and the atmosphere during centuries past, with the result that a "clayey" residue remains, the alkali being replaced or washed away, and the residual clay forms one of the main constituents of soil. Many rocks and all the ordinary clays contain a considerable proportion of aluminium, in the form of impure silicate of alumina, but since they do not readily lend themselves to economical treatment for the production of the metal they are not extensively used.

The most important natural compounds are:—(1) Bauxite ($H_6Al_2O_6$); (2) cryolite ($Al_2F_6 6NaF$); (3) wavellite ($2Al_2P_2O_8$, $H_6Al_2O_6$, $9H_2O$); (4) aluminate (Al_2SO_4 $9H_2O$); (5) corundum (Al_2O_3, impure form); and (6) topaz ($5Al_2SiO_5$, Al_2SiF_{10}).

Bauxite and cryolite are the two minerals usually used for the production of aluminium on a commercial scale, their preference lying mainly in their purity. Perhaps the main problem in the metallurgy of the metal arises from the fact that once produced the metal cannot be easily refined, and any impurities which are present in the minerals may become incorporated in the metal, and their removal necessitates expensive processes. Therefore, for the production of the pure metal, it is necessary to use the purest material obtainable, this applying to both the mineral and the other materials which come into contact with the metal during manufacture.

Bauxite—$Al_2O_3,3H_2O$

Bauxite was first found near the town of Beaux in France by the French chemist Berthier in 1822, from which it derives its first name of "Beauxite," and is chiefly a combination of diaspor, $Al_2O_3H_2O$, and brown hematite, $Fe_2O_3H_2O$, the colour varying from white to brown, depending upon the percentage of iron present. The ore presents numerous varieties, which are usually classified in two principal classes—the red bauxite and the white bauxite. The red bauxite, or ferruginous, is generally compact, pisolithic, or offering sandy aspect. Because of its small percentage in silicon it is preferably employed for the fabrication of aluminium. The white bauxite, generally silicious, presents itself in compact, amorphous masses. It is generally employed for the preparation of sulphate of alumina, of alum, and the fire-bricks, as it has the property of resisting to very high temperatures without melting. The percentage of alumina in the red bauxite varies from 50 to 70 per cent. with 2 to 5 per cent. of silicon. The percentage of the white bauxite ranges between 60 to 80 per cent. of alumina, 2 to 3 per cent. of iron, and 12 to 15 per cent. of silicon.

TABLE I.—*Composition of Bauxite from Georgia*

Entity.	Dark Specimen.	Light Specimen.	
SiO_2 ..	2.80	—	2.30
Al_2O_3	52.21	57.25	56.88
Fe_2O_3	13.50	3.21	1.49
TiO_2 ..	3.52	3.60	3.55
H_2O ..	27.72	—	—
CaO ..	nil.	—	—
MgO ..	nil.	—	—
P_2O_5 ..	—	—	0.66

The name "gibbsite" is given to the crystalline variety of bauxite having a slightly higher water content. Large deposits are to be found in Styria at Wochien and Freisstritz in Austria; at Irish Hill, Straid and Glenravel in Ireland, and important beds in the vicinity of Hadamar in Hesse. Langsdorff, where can be noted the presence of lateritic bauxites containing trihydrated alumina in connection with primitive basaltic rocks. In Arkansas important beds were discovered in 1891; the Bryant deposit has a length of more than 20 miles, and the yield is estimated at 44,000,000 tons. In this deposit is found the granitic and the pisolitic bauxite in relation with kaoline syenite. The characteristics of these ores have caused many controversies, and their definition has been the object of various conclusions. This is due to the fact that the bauxites are found in the crust of the earth under the form of veins, fields, amorphous deposits having no constant organoleptic characteristics. Hardness, colour, density, texture, everything changes, even in the same deposit. In fact, the bauxite seems only an hydrated alumina, mixed with some various impurities such as silica, sesquioxide of iron, titanic acid, and carbonate of lime.

Bauxite has been discovered in Floyd County, Georgia, U.S.A., which is described as follows in a Paper before the American Institute of Mining Engineers by Mr. Edward Nicholls:—"Numerous float specimens, covering an area of about half an acre, indicate the location of the main deposit, which has thus far been opened to an inconsiderable extent only. The excavations show the bauxite to exist apparently as large masses in clay. The formation is determined by the Geological Survey of Georgia to be Lower Silurian. The surface in the immediate vicinity is covered with numerous fragments of chert, a characteristic rock throughout this formation in Georgia. An examination of the mineral shows it to have the oolitic structure common to several bauxites. It varies in colour from light salmon to dark red, according to the content of iron sesquioxide. The light-coloured specimens are comparatively soft, while the dark-coloured are much harder, spots in them being harder than quartz. The chemical composition is interesting, because of the presence of titanic acid, in which it resembles the mineral found in Asia Minor. It dissolves with difficulty

TABLE II.—*Analyses of Bauxite.*

No.	Al_2O_3	Fe_2O_3	SiO_2	TiO_2	$CaCO_3$	H_2O	Moisture.
1	30.30	34.90	—	—	12.70	22.10	—
2	55.40	24.80	4.80	3.20	0.20	11.60	—
3	69.30 (1)	22.90	0.30	3.40	—	14.10	—
4	76.90	0.10	2.20	4.00	—	15.80	—
5	61.89	1.96	6.01	—	—	27.82	—
6	63.16	23.55	4.15	—	—	8.34	—
7	62.05	1.66	2.00	—	—	30.31	3.50
8	87.30	1.43	6.40	3.99	—	0.88	—
9	62.46	0.81	4.72	0.23	—	31.03	—
10	57.58	0.96	9.38	2.76	—	29.12	0.35
11	39.92	16.84	20.00	1.47	—	19.52	1.25
12	61.00	2.20	2.10	—	—	31.58	3.12
13	49.90	4.13 (2)	18.38	—	—	27.59	—

(1) Insoluble. (2) Includes both FeO and Fe_2O_3.

* Jour. fr. prakt. Chem., 66, p. 470.

in acids, but fuses easily with potassium acid sulphate. Owing to the purity of the deposit it seems likely to have a good value for use in aluminium reduction processes or as a refractory material." The chemical analysis of each specimen is shown in Table I.

In a Paper to the Mining Industry by C. H. Gordon, the author gives some interesting information with reference to the mineral bauxite. Bauxite exhibits a variety of textures, the most common being a pisolitic or oolitic ore consisting of rounded, concretionary grains ranging in size from that of a pea up to 1 in. in diameter, enclosed in a matrix of amorphous or clay-like ore. Another type found in certain deposits is the "granitic," which preserves in varying degrees the granitic texture of the syenite, from which the ore is derived. The colour of the ore varies greatly, also grading from light buff or white through grey to yellow, brown or red, depending upon the content of ferric iron. In hardness the ore may vary from that of a limestone to soft clay-like material that can be shovelled without picking. The upper portions of a deposit are usually harder as a result of the process of induration or cementing. Bauxite melts at 1,820 deg. C., and bauxite clay at 1,795 deg. C. Bricks made from the unrefined bauxite ore melt at 1,740 deg. C.

Cryolite (Al_2F_6, 6NaF).

Cryolite was first found at Ivigtuk, in Arksutfiord, in South Greenland, as a white glassy crystalline solid which resembles clouded ice in appearance, hence its name cryolite—literally "icestone," from the Greek kryos, ice; lithos, stone.

In the native state it is yellowish or reddish, and not infrequently is found mixed with sulphides of lead and silica, iron carbonate, and sometimes columbite. A very satisfactory artificial product which serves as a substitute has, however, been produced, and this corresponds in composition to the formula $Al_2F_6.4NaF$. This material melts at a temperature near 1,000 deg. C., and is capable of holding a considerable amount of alumina in solution; the addition of 5 per cent. of alumina lowers the melting point to 915 deg. C., and it is a fused mixture of this strength which is employed in the electrolytic reduction of the metal. Cryolite is a very fusible body, and is decomposed by sulphuric acid yielding hydrofluoric acid. Soap makers first used purified cryolite for its soda, for which purpose it is heated with milk of lime or fused with lime, and calcium fluoride and sodium aluminate are formed.

$$Na_3AlF_6 + 3CaO = 3CaF_2 + Na_3AlO_3.$$

The aqueous solution is decomposed by passing in a current of carbon dioxide, whereby sodium carbonate (soda) is formed and aluminium hydroxide is precipitated.

$$2Na_3AlO_3 + 3CO_2 + 3H_2O = 3Na_2CO_3 + 2Al(OH)_3.$$

Some time ago cryolite was used in connection with the manufacture of a patent white glass as a substitute for porcelain, but it is now discontinued, as a flux cryolite is extensively used. It is also used in the manufacture of alum and aluminium salts, sodium salts, hydrofluoric acid and the fluorides.

Pure cryolite contains:—Aluminium, 13.0; fluorine, 54.5; and sodium, 32.5 per cent. Or stated in fluorides:—Aluminium fluoride, 40.25; and sodium fluoride, 59.75 per cent.

Corundum. (Al_2O_3).

Corundum is found extensively in America as a colourless solid. Finely powdered corundum, a mixture of two-thirds alumina and one-third iron oxide commercially called "emery," on account of its great hardness, which is nearly equal to that of diamond, is employed as a grinding material for steel, glass and other hard substances. Transparent corundum tinted with various metallic oxides is valued as a gem; a red variety induced by the addition of a little chromium oxide is the "ruby." Artificial rubies have been made by heating together a mixture of alumina, chromic oxide and boric oxide. The boric oxide fluxes the mass and gradually volatilises, leaving behind the crystalline combination—ruby. Similarly, by the admixture of various other metallic oxides with corundum, sapphire, amethyst, etc., are obtained. A very large deposit is in working in the region of Corundum Hill, Maçon County, America.

Aluminium Sulphate ($Al_2(SO_4)_3.16H_2O$.

Of all the salts of aluminium, the sulphate is the one which has the largest application, and is therefore manufactured extensively. As "native alum" in 1884 a large deposit was discovered around the Gila River in New Mexico. According to W. Richards, the mineral was yellowish-white in colour, and consisted of layers of white, pure-looking material arranged with a fibrous appearance at right-angles to the lamination. Separation of the layers displayed a deep yellow substance harder and more compact, having a strong "alum" taste. On investigation the substance was found to be hydrated sulphate of alumina, the harder layers sulphate of lime. Analysis showed 7 to 8 per cent. of insoluble matter, and the remainder consisted mainly of $Al_2(SO_4)_3.16H_2O$, with a small amount of hydrate of iron.

A basic aluminium sulphate in which sulphanion has replaced one of the hydroxyl groups is found as native "aluminate" $Al_2(OH)_4SO_4.7H_2O$, and is used in the preparation of normal aluminium sulphate.

Common Aluminates.

Zinc Aluminate.—Zinc aluminate occurs in nature as the mineral gahnite $ZnAl_2O_4$.

Magnesium aluminate as spinell ($MgHAl_3O_6$), and can be regarded as the anhydride of monomagnesium aluminate, $MgAl_2O_4$.

Iron aluminate as horcynite, $FeAl_2O_4$.

Further information with reference to native aluminous minerals will be introduced in further sections, but it is felt that the preceding matter forms a satisfactory *résumé* of the principal natural occurrences of alumina for the metallurgist and founder, who is more eager to work the metal and its alloys than to study a detailed account of its forms in nature.

Salvage Work at Scapa Flow.

The difficult operations which Messrs. Cox & Danks, Limited, the well-known ship-breaking and salvaging contractors, have undertaken in raising the scuttled German war vessels at Scapa Flow are now proceeding satisfactorily, after a period of preparation extending over several months. It will be remembered that after some unsuccessful attempts the German destroyer V70 was recently refloated by means of steel hawsers attached to the ex-German floating dock for lifting submarines.

This dock, which was originally 400 ft. long, was towed to Scapa Flow and cut athwart in two halves, each 200 ft. long, by oxy-acetylene torches, thus forming two lifting pontoons. Each pontoon is fitted with the necessary equipment and machinery, including ten 10-ton triple-geared hand-operated lifting winches, each set with a 100-ton block and tackle attached to it. Along one side of each pontoon are 10 pulleys keyed on a shaft extending the whole length of the pontoon.

Two attempts were made to raise this particular destroyer. In the first attempt 3-in. studded chain cables were passed over the pulleys on the side of the pontoons and underneath the destroyer; but after being lifted about 8 ft. one of the links broke and the vessel sank to the bottom. Although the attempt had been unsuccessful, it had proved that it was possible to raise the destroyer, and a second attempt was made on August 1, when ropes of 9-in. circumference were substituted for the chains. In seven hours after operations had commenced the destroyer was raised in an upright position and towed to Mill Bay, where she was then grounded on a sand bank.

This year's working programme includes the salving of some 24 destroyers. A torpedo boat, S53 was raised last last week, and two destroyers have now been raised.

Maxim for Moulders.

Always have a stand-by in case you "miss the boat."—*Buchanan.*

The Analysis of Grey Iron Foundry Alloys.—III.

By H. H. S.

Silicon.

Of the numerous methods described in text books for the estimation of silicon, the writer recommends Drown's method as being the most satisfactory and rapid; it is also probably the most accurate. The method involves treating the sample with a dilute mixture of nitric and sulphuric acids; many chemists fight shy of this method on account of the obnoxious fumes given off by the H_2SO_4 on evaporation; this objection is, however, easily removed if evaporation is carried out in a properly constructed fume cupboard, provided with a forced-draught fan. Many laboratories are very badly equipped in this respect, and for this reason a second method is given here, involving the use of HCL.

By either method a residue of perfectly white silica can be obtained after ignition if the graphite-silica residue has been washed properly. With Drown's method the freedom of the silica from iron is much more easily attained than by the second method, and less washing is required. A perfectly white silica does not require treatment with hydro-fluoric acid, and it can be brushed out of the crucible—which can be porcelain—and weighed in a counterpoised scoop. The rapidity of solution and evaporation—provided that the correct amount of acid solution is used, the nicety of condition of the silica in respect to dehydration, etc—that can easily be obtained after a short baking, the ease with which the baked residue can be dissolved, filtered and washed, so as to give a perfectly white residue after ignition, and finally the accuracy obtainable, are details which have been closely watched by the writer when employing Drown's method, and have convinced him of its efficiency.

Drown's Method.

Reagents or Solutions Required:—*Nitro-Sulphuric Acid.*—Mix 200 c.c. of concentrated H_2SO_4 with 1,000 c.c. of H_2O, cool, and pour into 500 c.c. of concentrated HNO_3.

Hydrochloric Acid.—One volume of concentrated HCL mixed with one volume of water.

Into a 4 in. dia. lipped evaporating basin, provided with a handle, weigh 0.94 grs. of the sample; add 25 c.c. of the nitro-sulphuric acid, and immediately cover with a 5-in. watch glass, as the reaction is very violent; place the basin on the front of the hot plate until the sample is nearly dissolved; it is essential that the sample be *completely* dissolved before the solution thickens. This can be assured by boiling the solution after the sample is for most part dissolved, removing from the plate for a minute or so, when completion of reaction will be indicated by absence of gas bubbles. The basin should be shaken so as to impart a swirling motion to the solution in such a way as to remove any particles which may have been projected up to the top of the basin side during the first violent reaction. The solution is now evaporated until *dense* white fumes are being freely evolved. Allow this to proceed for 1 to 2 mins., then remove the dish to cool. It is necessary to take to fuming (when the fumes are heavy and quite white) to ensure complete dehydration of the silica and its insolubility. After fuming the residue should be quite dry; if "spitting" or a thick sludge is created the cause is probably due to the presence of too much dissolving solution. The uncertainty and extra trouble caused if such is the case makes this point well worth noticing, in that no more than the stated quantity of solution should be used.

When the dish has cooled wash the cover glass and sides of the dish with 1 to 1 HCL; this operation is best carried out by allowing the acid to issue from the wash-bottle's mouthpiece, holding the bottle at an incline. The mouthpiece should have a bore not exceeding 2 mm.; this prevents too much acid being transferred to the dish—25 to 30 c.c. is ample. The cover and dish are then washed in the same way with hot water; to save time in filtering, it is advisable to keep the total volume under 60 c.c. Bring the solution to boiling; boil for about one minute, taking care to see that all the soluble salts pass into solution. Excess boiling tends to re-dissolve some of the silica. Filter through a 12.5 cm. corrugated No. 40 Whatman "ashless" paper, contained in a 3-in. dia. funnel. Filtering should be rapid to aid freeing of iron from the graphite-silica residue. For this reason the writer prefers the use of corrugated papers, which are quite easily and rapidly made. The old-fashioned four-fold papers, while simple to make, are rarely a success when used by juniors; and with incorrectly formed funnels where the angle is not truly 60 deg., they are a positive nuisance and irritation, whereas corrugated papers are not seriously affected in such cases.

In transferring the residue into the filter see that all adhering particles are removed from the sides and bottom of the dish by using a bobby.* This operation requires care. Too often the old saying, "What the eye doesn't see," is put into practice, yet it does not follow that having removed all the black particles the silica has all been transferred. Some of that freed from graphite particles is apt to be overlooked, especially in case of high silicon irons. Immediately after the mother liquor has passed the filter wash once with hot, but not boiling, water, keeping the jet well at the filter top at first, so as to avoid driving some of the residue over the top; after this has run through, wash once with 1 to 1 HCL, then treat once again with H_2O and acid, twice with H_2O, and finally wash residue well into the apex of the filter paper. With normal washing the above procedure results in a silica of pure white, after burning off the carbon and paper.

Remove the filterpaper from the funnel, fold as indicated in Fig. 8, and place in a 35 to 40 mm. dia. porcelain crucible, so that the residue is facing upwards as in Fig. 8, *c*. This method prevents possible adherence of the silica to the crucible, and it aids "brushing out." Dry on the hot plate, air oven, or on the muffle top, the latter is a suitable means if there is no dust or dirt about. When dry place in the muffle, allowing free access of air until the flames rising from the burning of the paper have died, then partially close the

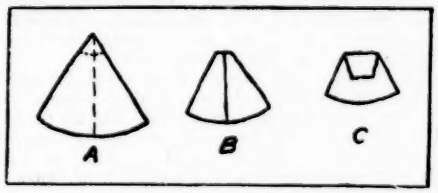


FIG. 8.

muffle front and heat at the highest temperature, not less than 900 deg., until the residue is quite white, which usually takes from 8 to 10 min. for silicons up to 2.0 per cent. and 15 to 20 mins. for higher silicons or lower temperatures. Remove the crucible from the muffle, allow to cool in a desiccator, then brush out the silica into a counterpoised scoop, by means of flat, short-haired, camel-hair brush. Weight of silica × 100 ÷ 2 equals per cent. silicon.

Hydrochloric Acid Method.

The sample weight used is the same as in the previous method, 0.94 grammes. This is treated in the evaporating basin with about 25 cc. of concentrated HCL. When the sample is nearly dissolved, boil to aid solution, then evaporate to complete dryness, and bake for 15 to 20 mins. Allow to cool and take up the residue with 25 cc. of concentrated HCL, and bring to boiling. Wash the cover glass and basin sides with water, so that the volume

* A piece of glass rod with short length of rubber tubing on the end.

equals about 60 cc., bring to boiling again, boil for about one minute to ensure solution of the salts. Filter, and in this method it is advisable to wash at least several times with HCL (1 to 1), and several more times with hot H_2O. Apart from this variation, the estimation is finished exactly as described under the nitro-sulphuric method. The ignited residue may be contaminated with a little iron, in which case, should maximum accuracy be required, or to remove all doubt as to the correctness of the result, the silica residue must be treated with hydrofluoric acid. Transfer the residue to a platinum crucible, weigh, now add a few drops of HF, and a couple of drops of dilute sulphuric (1 to 2) to the crucible, place in front of the muffle to allow evaporation of the acids. Here a little precaution is necessary to avoid spotting. When evaporation is complete, and the sulphuric acid fumes have ceased to evolve, place the crucible in the muffle and heat strongly for 5 mins.: remove, cool and weigh. Difference in weight × 100 ÷ 2 = per cent. silicon. The method just described has several advantages over the aqua-regia process, for example, the fumes are not so irritating, evaporation is more rapid, and the silica can be obtained more free from iron contamination: and it is strongly recommended where the nitro-sulphuric method is inapplicable or objected to.

By either the nitro-sulphuric or hydrochloric methods, duplicate estimations should check within 0.02 per cent., with the nitro-sulphuric method ordinary care and commonsense ensure results accurate to 0.01 per cent. without HF treatment.

Silicon in the Filtrate.

No matter what method is employed for the determination, it will always be noted that if the filtrate is evaporated to dryness a little silica is obtained, which indicates that some is dissolved up by the HCL used as the residue solvent. The amount of dissolved silica may be appreciable—as high as 0.20 per cent.—or it may be as little as 0.05 per cent. In the writer's practice it averages 0.07 to 0.10 per cent. From the above it is obvious that this often unreported soluble silica may make a very appreciable difference to a result, and therefore its presence and effect should not be neglected.

For normal practice, especially where one analyst has sole charge of the silicon estimations, it is not necessary to estimate the silica on each filtrate, the best way being to treat a number of filtrates, and take the average of the results, which for the same method, treatment, approximately same silicon contents of iron, and for a particular operator can be regarded as permanent. For extreme accuracy it is necessary to carry out blank estimations on the reagents used, but for ordinary practice this blank estimation may be neglected.

To estimate the soluble silica, transfer the filtrate to a 600 c.c. tall form beaker, evaporate to dryness, bake for 10 mins., cool, add 20 to 25 cc. HCL (1 to 1) and heat till residue is completely dissolved, then add 30 cc. H_2O, bring to boiling stir well, and allow silica to settle, filter, wash, dry and ignite, as in the nitro-sulphuric process, the silica being calculated to Si per cent.

Filter Paper Ash and its Determination.

When using "ashless" filter papers of the size and type recommended the weight of filter ash may be ignored in foundry work, except when estimating soluble silica present in the filtrate from the silicon estimation, when it should be deducted from the silicon found in solution. For the sake of completeness, however, the determination of filter ash is dealt with at this point, as it is sometimes required when one is for some reason forced to use lower grade papers, in which the ash is greater and more inconstant.

Each box should be tested, and it is advisable to treat at least eight papers. The papers are selected from different parts of the box, folded in pairs, so as to form four filters, and placed in four filter funnels. Wash with water first, then with acid and water exactly as when washing a residue or precipitate: after washing, place *two pairs* into one crucible and two into another, the crucibles having been weighed first: dry the papers carefully and then burn off to ash in the muffle. Difference in weight ÷ 4 = weight of ash per filter paper, the second series serve not only as a check upon the estimation but indicates the extent of uniformity of the papers throughout the box or boxes.

[We feel the author should have dealt with titanium, when covering the subject of silicon. We would recommend the institution of regular exploratory tests for this element to be tackled on the end of silicon determinations.—Editor.]

Cold-Laps in Cast Iron.

By J. H. List.

A cold lap in any form of casting whether in a machine tool part, an engine part, a fly-wheel, pipes, or in almost any casting, will make it a waster. If it is a casting that is subjected to strains such as an engine bed, a cold lap will weaken the structure, especially if it is a casting which has to withstand an internal fluid pressure. These few cases are given to show that a cold lap in a casting is a bad fault and one that no foundryman can afford to overlook.

Causes of Cold Lap.

A common cause is the use of cold metal. It is often stated that moulds must be run white hot to ensure a good casting, but this is not necessarily true. Is not this statement often confused with the fact that iron must be melted hot to ensure good castings? Obviously, iron must be sufficiently hot for the mould under review. In the case of light castings, but of rather larger dimensions, the metal must be hot or troubles will arise from cold laps.

The runner gates must be sufficiently large to allow the iron to pass through into the mould before solidification sets in. When cutting runner gates, the question of the temperature of the iron must be considered during the confection of the mould, and the size of the gates decided upon.

Metal will solidify from a white hot temperature of 1,350 deg. C.; in a mould where the section is fairly thin in a minute or two.

The speed of teeming varies somewhat with the class of casting and no hard and fast rule can be established. The following figures indicate the author's practice:—

Size.	Weight.	Approx. pouring time.
Bedplate 34′ × 8′ × 5′..	440 cwts.	3 mins.
Engine cylinder.. ..	50 ,,	2 ,,
Cylinder pistons ..	7 ,,	1 min.

It is not sufficient to cut the runner gates large enough, but they must be placed in the correct position. This is a point where no definite rule can be enunciated, but what should be borne in mind is, if there is more than one runner entering the mould at opposite ends, the metal has not so far to travel and is not so likely to get chilled so quickly.

Cold laps are often caused through plumbago or blacking running loose before the metal. This is usually due to defective material. Mould facings of this type should be so constituted that when well-sleeked they will firmly cling to the mould face. They must also not fuse or burn in contact with the molten metal, thus loosening them and allowing them to flow before the metal. It is a common practice, but one which the author depreciates, of shaking plumbago or the like into a mould where it is quite impossible to sleek, and blowing away the surplus with the bellows. If it is necessary to face a mould of such a description it is preferable to make a plumbago-wash and to apply with the finest camel hair brush. These forms of cold laps, however, will only occur on light castings. Even on heavy castings, however, lines can often be seen on the outer surface showing where plumbago has collected.

Cold laps are also formed if the moulds are too damp. In such a case the metal is chilled somewhat, and cools much quicker.

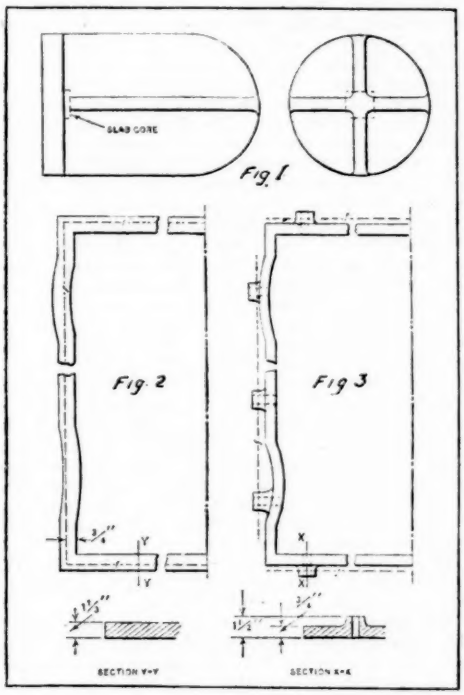
The author is of the opinion that such faults as cold laps occurring in castings having cores are too often put down to the fact that the core has lifted and made a thin place and consequently formed a cold lap. If, however, cold laps were studied more closely it would often be found that trouble lies in one of the five reasons outlined.

Designing Steel Castings.*

By E. R. Y.

When relatively small holes are required in thick sections of heavy castings it is preferable to avoid the use of cores and to drill or otherwise remove the metal. An excellent example of a casting of this type is the ram of a steam hammer. There are three objections to coring out the bore of the ram. In the first place, the sand of the core will "burn in," because the heavy section of metal surrounding the sand core subjects it to great heat and causes fusing of the sand and metal. This will occur in spite of great care on the part of the foundryman, and it will cause the boring tools to wear out quickly. Also the time consumed in machining is usually much greater than when the hole is drilled or bored from the solid metal. Another reason for not using a core in such cases is that it is likely to be forced out of position by the pressure of the molten metal. The core print also interferes with the placing of a large sink head on the end of the ram, and makes necessary the use of two smaller heads, one on each side of the core. With the latter method it is more difficult to secure solidity in the body of the casting.

Good practice demands that die blocks should be cast on end, with the head on the end and not on the side. Time may be saved in machining by



making the castings with projections and depressions so that the surfaces that require machining will be comparatively small. Now, if the parts of the pattern carrying the projections and depressions are not made as loose pieces so that the pattern can be drawn from the sand endwise, it may be necessary to cast it with the head on the side, which will result in an inferior casting. The difference of opinion among manufacturers as to the merits of cast-steel rams and die blacks is, in many cases, due to the unfavourable experience of some users who received castings made under adverse foundry conditions which prevented the obtaining of a first-class product.

On the majority of castings there are some parts that have working or wearing surfaces or surfaces that require a very smooth, true finish. Such parts should be made in the lower part of the mould or drag, as any foreign material which may be entrapped, or sand which may be washed loose by the metal, will rise to the top of the mould and appear on the upper or cope side of the casting. There is also less chance of sponginess in the lower part of the casting where the pressure of the metal in the sink heads or risers is most effective in securing solidity.

It is a simple matter for the foundry to take proper care of these important surfaces, provided it is informed as to their location on the casting, and provided also that the pattern is so made that it can be moulded in the drag. If, for example, the rapping plates to be used in drawing the pattern from the mould are located on one of these surfaces, the logical thing is for the foundry to make the mould with this side of the pattern up, assuming that this is the customer's intention in so making the pattern.

Engineering or Structural Design.

Castings range in design from very simple members to very complex structures, and the proper designing of them is accordingly a simple or a difficult matter. With the usual design of simple castings, the foundryman has very little concern as regards the unit stresses. The sections are generally ample, considering the load applied, as a generous factor of safety is always employed. The strains imposed on a casting during solidification and cooling in the mould are, in a measure, a test of its strength while in a much weaker condition than that in which it will be used.

The importance of some of the simpler rules of design, such as avoiding extreme concentration of stresses due to sudden changes of section, sharp corners, etc., is often brought to the designer's notice through failures caused by stresses set up while the casting is cooling. Such failures, which result in a scrap or a repaired casting, might not be duplicated in service under different loading conditions. For instance, a casting which cracked under tension in cooling might be under compression when in use. Nevertheless, the properly designed casting will stand up under cooling stresses as well as under working stresses, and with intelligent handling in the foundry, it should never come from the mould in a state of internal stress, which is but little short of failure.

One method of securing a more uniform section at the junction of several parts is to use a lightening core which cuts through the parts close to or at the intersection, thus reducing the mass of metal at this point. Fig. 1 shows such a core used where four webs or parts join a fifth part. This use of a core has been made the basis of a patent for a cast vehicle wheel. Castings should be provided at all corners with good fillets, which should be much larger in radius than would be used to relieve a sharp corner on a machined part.

The vital parts of a casting, which require maximum solidity, should not be surrounded with parts so light in section that the early "freezing" of the light parts will prevent adequate feeding of the important parts during solidification. This matter of properly feeding the different parts of a casting with molten metal from the heads during solidification is one which cannot be left entirely to the foundryman, although the latter in most cases, can provide for the adequate feeding of molten metal by the proper location of heads and gates. Nevertheless, the designer should see to it that the sections are such as to permit of adequate feeding.

Warping is of considerable concern to both designer and foundrymen. In a box-like casting with thin walls warping is practically unavoidable, and becomes more pronounced the greater the length of the casting. When the faces of such a casting are machined to a true surface, preparatory to assembling, the walls are likely to be too thin at certain points where strength is required as indicated in Fig. 2. Some designers avoid this trouble by using bosses to provide bearing surfaces for assembling other parts, as shown in Fig. 3. These bosses can all be machined and the parts accurately assembled, regardless of any irregularity in the outline of the wall, which will retain its full thickness at all points.

Castings of Intricate Design.

As castings become more intricate and complex in design the calculation of the stresses in the different parts becomes more difficult and finally impossible in the light of our present knowledge of compound stresses. Castings of this type are

* Abstracted from *Machinery*.

usually designed to have sufficient strength as regards the size of sections and the factor of safety.

Where irregular shapes are required, castings are usually employed, and therefore parts in which there is a concentration of stresses due to changes in section and in form are of common occurrence. The fact that there are parts where the stress is higher than the average unit stress for the section is quite generally recognised, but the extent to which the stresses at such points of concentration exceed the average stresses is, perhaps, not realised. The effect of an abrupt contraction in the cross section of a piece under tension or bending in increasing the maximum stress, is really surprising. For example, in a piece under tension which has a round hole through the section, the calculated maximum stress at the periphery of the hole where the concentration of stress occurs is over three times the average stress in the section. Another example of such stresses is the maximum unit tensile stress occurring in a chain link. This, according to some authorities, is about twice the average unit stress for open link chain, and 1.6 times the average stress for stud link chain.

It is easy to visualise castings or parts of castings which, when under load, correspond to a tension member having holes or grooves in its cross section, and also castings or parts of castings which, under load, correspond to a chain link under tension. Therefore, it can be stated that castings are frequently of a design that involves conditions of highly concentrated stresses. In some cases failure may be attributed to a lack of strength in the material, when the full strength has actually been developed under the peculiar conditions of loading. When we consider also that it may be difficult for the foundry to secure maximum solidity of metal at certain points, due to restrictions imposed by the location of other parts, we can readily see the need for thorough preliminary analysis of conditions by the designer in working out his sections and shapes.

Intercrystalline Cracking of Steel under the Influence of Caustic Solutions.

Messrs. R. S. Williams and V. O. Homerberg, in a Paper presented to the American Society for Steel Treating, summarise their research with the following conclusions:—

(1) During the crystallisation of steel, the impurities, to a considerable extent, are rejected to the grain boundaries.

(2) The oxides and sulphides are two of the prime factors in caustic embrittlement.

(3) The oxides are reduced under the influence of cathodic hydrogen.

(4) The sulphides are removed due to the action of hot caustic soda solutions.

(5) The removal of the sulphides produces a surface condition favourable to progressive corrosion.

(6) Assuming that progressive corrosion starts with the removal of the sulphide, the corrosion will be greatly accelerated if the material is stressed. Furthermore, when the steel is under tension there is a tendency for the matrix to pull away from the inclusions at the grain boundaries and in this manner to produce small capillaries into which the corroding solution can penetrate.

(7) In stressed areas containing oxides, the volume increase due to the reaction with cathodic hydrogen may produce stresses which, added to those initially present, may cause cracking.

(8) It seems evident that hydrogen acts in three ways to produce embrittlement; first, the temporary brittleness caused by absorbed hydrogen (as in acid pickling); second, it acts to reduce oxides; and third, its effect due to the change in volume at the grain boundaries, resulting because of the production of water. This latter volume increase would create a stress which, added to those originally present, may cause cracking, especially at those points where these stresses are at a maximum.

Institute of British Foundrymen.

Newcastle Branch Junior Section.

On a recent Saturday members of the Junior Section had the privilege, through the kindness of Mr. A. Munro Sutherland, of paying a visit to the "Newcastle Chronicle" Printing and Publishing Department. The visitors were received and shown round by Mr. F. H. Parsons.

The "Newcastle Chronicle" is equipped with all up-to-date methods and machinery for collecting, printing and distributing news.

In the first department to be visited, considerable interest was shown in the "Creed" machine. In the London Office a tape is punched in Morse code signals, which are transmitted, by means of electrical oscillations, to the Newcastle Office, where they are reproduced on another tape. The Creed printer awaits the tape and, by a very ingenious device, it translates the Morse code and prints it out in full ready for the sub-editors. The average speed of transmission and reception by this system is about 100 words per minute. There were three of these machines working at the time of the visit.

The Linotype machine, which turns out lines of type known as slugs, also attracted much interest. There are 36 of these machines. The news having been set into type on the "lino," is proofed and corrected.

The assembling is carried out within a steel frame which, when full, is securely wedged and passed along to the stereotype room. A prepared paper known as a "flong" is used for the purpose of taking impressions from the formes or pages of type. This paper is pressed on to the type and then dried, the dual operation occupying less than a minute. The flong, being flexible, easily fits into the auto-plate casting machine. Molten metal is pumped into the mould so formed and in a very short time the plate is ready. Semi-circular in shape, the plates are made to fit the cylinders on the big printing machines. The rate of production is five plates per minute, the weight of each being about 54 lbs. The stereotype metal from which the plates are cast consists of a mixture of lead, antimony and tin.

A balance lift carries the plates to the printing room where they are locked in position on the cylinders of the huge press. The paper, which is fed from large reels, passes between the revolving cylinders, the outer ones carrying the stereotyped plates and the inner ones being covered by printers' blankets. The printed sheets are drawn down V-shaped formers, giving them the folds, and are finally ejected on to a "spider" neatly stacked and counted into heaps of 50 papers. The machines are capable of printing, folding, cutting and counting 1,000 papers per minute.

The printed papers are then taken to the despatch room. The rate of despatch is exceedingly fast and equals the printing rate.

The photographic department was also visited. Here the exposed plates are developed, and while still wet are printed by an automatic enlarger, which requires no focussing, and dried on an electric dryer.

The editorial staff, having selected the prints, passes them on to the process department, where blocks are made.

The different machines and methods were very fully explained by Mr. Parsons, and the visit proved exceedingly interesting.

Canadian Production of Lead.—The Canadian Bureau of Statistics Bulletin gives the lead production of the Dominion last year as 55,617 tons, an increase of 19 per cent. compared with 1922.

Canada's Iron and Steel Imports from United States.—Canada's imports of iron and steel from the United States increased greatly during the fiscal year 1923-24, the trade having a total value of $152,176,749 (a gain over the two preceding years of $27,806,556 and $52,238,514 respectively). This constitutes rather more than 87 per cent. of Canada's imports from all countries under the general classification. Imports from Great Britain, on the other hand, bore a proportion of only a little over 10 per cent. to the total, their value being $18,241,866. The increase in the imports from the United States extended to all general classifications of iron and steel.

Trade Talk.

SPEAR & JACKSON, LIMITED, have purchased the business of the Ætna Saw Company of Vancouver.

THE ADDRESS of the Accumulator Makers' Association is now 49-50, Parliament Street, Westminster, London, S.W.1. Mr. D. C. McLagan has been appointed secretary.

OVER 100 FIRMS have already taken space at the third Machine Tool and Engineering Exhibition, which will be held at Olympia, London, S.W., from September 5 to 27.

A SCHEME for the reconstruction of the steel bridge across the River Team, Gateshead, is being considered. The scheme has been approved by the Town Improvement Committee.

IN ORDER to cope with increasing business, Wailes Dove Bitumastic, Limited, of Newcastle-on-Tyne, have acquired large works and a site of 8½ acres at Hebburn-on-Tyne, together with offices and laboratories, where they intend to install an entirely new plant for the manufacture of their specialities.

THE WEST SOMERSET MINERAL RAILWAY was sold by auction at Watchet, recently, for £3,019. The railway, which was some eleven miles long and was carried to the top of the Brendon Hills, served largely for iron-ore traffic. Then the mines were closed, and a few years later all traffic on the line ceased.

THE SPRINGVALE STEEL WORKS, Bilston, of Alfred Hickman, Limited, have now been reopened for work. The works have been standing idle for over a month in consequence of a wages dispute. The strike itself has not been settled, and it is stated that no negotiations are proceeding. Many of the strikers are stated to have asked to resume work.

AN IMPORTANT RAILWAY improvement is nearing completion in connection with L.M. & S. system at Rotherham. By a line and sidings which have been made, Steel, Peech & Tozer, Limited, for the first time obtain direct access to the old Midland Railway. The new line connects up with the south end of the Masborough sorting sidings, is about three-quarters of a mile long, and has entailed an outlay of about £25,000. The Sheffield road is spanned by a 60-ft. steel girder bridge, and carries a double line into the newer portion of the works. On the other side of the bridge there is a group of four sidings just over a third of a mile long. Then the line becomes single to the joining with the Masborough sidings.

IT IS REPORTED by the Federation of British Industries that recently tenders were called for in Chile for three locomotives of the Mikado type for the Arica-La Paz Railway. Hitherto, the Chilian Government has always obtained these locomotives at the lowest cost from the United States, but the tenders presented in the present instance disclosed a position which is of considerable interest as showing the competitive prices. The figures per locomotive were, roughly, as follow :—Belgian manufacture, £4,700; German, £4,756; U.S.A., £7,550; British, £9,260. This was the lowest British tender, and illustrates only too graphically the chances the British manufacturers have of doing business in the engineering line in South America.

THE new monthly ascertainment price of Cumberland hematite pig-iron, mixed numbers, is £4 17s. 10.94d. per ton, being a decrease of 1s. 1.74d., as compared with the previous month's price, which was £4 19s. 0.68d. In consequence of this decrease, the wages of Cumberland iron ore miners, which, according to agreement, are based on the monthly ascertainment price, will be reduced by from ½d. to 1d. per day, and for the ensuing month will be as follows (per day or shift in each instance):—Miners' working bargains, 9s. 10d.; miners' minimum, 7s. 2d.; underground leading labourers, 6s. 3½d., blacksmiths, 9s. 0½d.; chargemen and mineral shot borers, 9s. 0½d., plus 3d. per foot; joiners, 9s. 0½d., plus 6d. tool allowance.

B.S. Specification for Normal Type Tungsten Filament Electric Lamps.—This specification (No. 161-1924), which has just been issued by the British Engineering Standards Association, supersedes B.E.S.A. Publication (No. 133-1921) Normal-Type Vacuum Tungsten Filament Lamps. It contains, besides general clauses covering all types of tungsten-filament lamps, schedules setting out the required performance, etc., for gas-filled and vacuum-type lamps. Further schedules for traction lamps, train-lighting lamps, etc., are being prepared and will be added as and when ready. In this new specification the basis of the rating of lamps has been changed, the life performance being based on candle-power maintenance throughout life, whereas the previous specification was based on initial performance with a limited reduction in candle power and efficiency. Another important change is the use throughout the specification of lumens as well as candle power. Copies may be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, London, S.W.1. Price 1s. 2d., post free.

Obituary.

PROFESSOR JULIUS WERTHEIMER, Dean of the Faculty of Engineering and Professor of Applied Chemistry at Bristol University, died at Bristol on Saturday last, after a short illness, at the age of 64.

MR. H. TODD, of Alexander Street, Coatbridge, died recently. He was a son of the late Mr. J. Todd, manager of the Waverley Ironworks, and for 25 years had been an iron and steel inspector at the Clydesdale works of Stewarts & Lloyds, Limited.

MR. JAMES BULCOCK, who died recently, was formerly head of the firm of James Bulcock, iron and metal merchants, Manchester Road, Burnley, retiring in 1911, when the firm was converted into a limited company. He was in his 72nd year.

Gazette.

THE LAST DAY for receiving proofs in connection with a dividend to be paid by Mr. H. G. Smith, The Green, Urchfont, near Devizes, iron and hardware merchant, is August 19.

MESSRS. T. A. CLARKE, E. CLARKE, AND E. ATKINS, general metal merchants and manufacturers, 84, Lombard Street, Birmingham, trading under the style of J. Clarke & Company, have dissolved partnership. Mr. T. A. Clarke will continue the business.

THE PARTNERSHIP heretofore subsisting between Messrs. E. A. Herbert and W. J. Krogsdal, iron, steel and metal merchants, Gwydir Chambers, 104, High Holborn, London, and 25 to 28, Suffolk Street, Birmingham, under the style of E. A. Herbert & Company, has been dissolved. Mr. E. A. Herbert continues.

AS PREVIOUSLY REPORTED, the shareholders of the Widnes Foundry Company, Limited, have agreed, in view of the company's liabilities, that business cannot be continued and that the company be wound up. In a circular to shareholders and creditors the liquidator states that liquidation has been decided upon in order to protect the general body of creditors. Although it is felt the company cannot carry on its business because of its immediate liabilities, the liquidator states there is every reason to believe that the creditors will ultimately be paid in full, or very nearly so. It has been decided to continue the business, as regards the completion of contracts and acceptance of further orders, until the statutory meeting of creditors.

Personal.

MR. C. F. BENGOUGH, chief engineer of the north-eastern area of the London & North-Eastern Railway, is resigning his position at the end of December next.

MR. R. D. PAGE has been appointed manager of the Newcastle branch of Siemens and English Electric Lamp Company, Limited. He was formerly connected with the Southampton branch of the company.

MR. F. J. TROTTER has been appointed district traffic manager at Doncaster; Mr. J. Showers district goods manager at Manchester; and Mr. P. S. Ludlam district goods manager at Liverpool, for the London & North-Eastern Railway.

MR. W. E. BULLOCK, an American engineer, it at present visiting Europe. He is interested in the Leon Cammen centrifugal casting process. His address is c/o The Institute of Mechanical Engineers, Storey's Gate, London, S.W.

MR. J. P. BRUCE has relinquished his position as manager of the iron and steel department of John Batt & Company (London), Limited, to take up an appointment with Dodwell & Company, Limited, 24, St. Mary Axe, London, E.C.3.

MR. JOHN HORNE, has been appointed export sales engineer for Johnson & Phillips, Limited, at 12, Union Court, Old Broad Street, London, E.C.2. Mr. Horne has previously been connected with the Metropolitan-Vickers Electrical Export Company, Limited, the British Westinghouse Company, and the Westinghouse Electric International Company.

Wills.

MACPHERSON, G., ironmaster, of the Lloyd House, Penn, Wolverhampton, Staffs ...	£126,370
BURTON, T., of Stafford Road, Wilderspool, Warrington, manager to Monks, Hall & Company, Limited	£12,978
HOMER, A., senior partner in Anderson & Homer, malleable iron and brass-founders, Frederick Street, Walsall.....	£8,232

Maxims for Moulders.

A good mender is always a good moulder.—*Buchanan.*

A tool in the hand is worth two " in the sand."—*Buchanan.*

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—In view of the celebration of Stockton race week holidays, business on the Cleveland iron market has been practically in abeyance during the week, but fair quantities of iron are stated to have been recently disposed of by makers for home consumption, although so far merchants, at all events, have not experienced any revival. With the arrival, however, of more settled conditions in the European political situation, hopes are renewed of a revival in both home and export activities, and generally the outlook for Tees-side is now regarded as more favourable than has been experienced for a long time past. In the meantime the standard No. 3 G.M.B. quality is offered at 85s. per ton, and for large parcels this could no doubt be shaded. No. 1 is quoted at 90s., No. 4 foundry at 84s., and No. 4 forge at 83s. per ton. The hematite market continues very weak as regards inquiry, both from at home and abroad.

LANCASHIRE.—Business in the local market for pig-iron continues stagnant, while there seems to be considerable divergence between the views of sellers of pig-iron and consumers. Sellers maintain that we are now on a rock-bottom basis of values, and it is currently reported that merchants recognise this fact, and are now buying pig-iron in considerable quantities as a speculation. It is, however, assumed that local ironfounders, viz., the actual consumers of the pig-iron, are confidently anticipating a lower level of prices, and say that they can wait easily until the price in Manchester reaches 90s.; in other words, they wait for another fall of 5s. per ton to be added to the drop of 5s. which has already occurred. The local demand for Scotch iron is only very small at present, but should increase if the textile engineers get busier. The price is now fairly moderate at about 108s. 6d. to 109s. per ton, say, 13s. to 14s. more than common iron in Manchester.

THE MIDLANDS.—Conditions in this area are quite an exception to the general tendency of pig-iron markets as the only centre of the industry evidencing any activity worth mentioning. There has been a fair demand in foundry grades during the last fortnight, and both the merchants and the larger consumers have covered their requirements for two to three months ahead, realising that the existing figures will not fall, and that any alteration will be in an upward direction. The ruling quotations are as follow:—Derbyshire No. 3 foundry, 85s. to 87s. 6d.; Staffordshire No. 3 foundry, 85s. to 87s. 6d.; Northants No. 3 foundry, 82s. 6d. to 83s. 6d.

SCOTLAND.—Business in the Glasgow pig-iron market remains dull and listless, while prices continue weak, with No. 3 Scotch foundry quoted to-day at 92s. 6d. per ton at the furnaces. There is an inclination amongst traders to look for an improvement setting in about this time, but so far there are no actual signs of it in pig-iron. In fact, it is reported that some of the pig-iron producers intend damping down their furnaces, and this must be taken as a sign that, in their opinion at least, there is no prospect of business improving.

Finished Iron.

The outlook in the manufacturing branches of the industry can hardly be regarded as encouraging from an optimistic standpoint, business remaining extremely flat and uninteresting. Although there are only a few ironworks in operation in South Staffordshire, they are not receiving anything near sufficient tonnage to keep them going regularly. A few wagon specifications have been given out recently; orders for marked and tested irons are better than for the crown and more common irons, but that is not saying a great deal. Orders are scarce all round, but more particularly in the nut and bolt section. There is no alteration in prices, marked bars being £15 f.o.t.; crown iron, £12 15s. to £13; and nut and bolt iron, £11 15s. to £12 delivered. There are plenty of Continental quotations for iron bars at £7 15s. delivered for No. 3 quality, and £8 for the better grade. A few orders have gone abroad, but the total tonnage is light.

Steel.

The tendency of markets for steel and its products at the moment is extremely apathetic, the actual business passing being restricted in volume, and mostly confined to transactions in semi-manufactured material. There is only a quiet demand for British billets, but the recent stiffening of Continental rates of exchange has steadied the market for semis somewhat. Previously Continental steel had shown a downward tendency. There is still, however, a big margin between Belgian and home prices, sufficient to enable Belgium to secure all the business wanted from this market. Naturally, the British quotation is very weak in face of the competition. The depression in steel is apparent in the ferro-manganese trade and the home price has been further reduced to £13 10s. per ton. Business at home is exceedingly poor and for very small parcels, the recent drastic cuts in prices, although very welcome to the steelmakers, not having materially affected the demand. The reduction in the output of tinplates consequent upon the holiday period, together with the recent rise in tin, have imparted a firm tone to the market.

Scrap.

In common with the absence of activity in all sections of the iron and steel trades, the demand for scrap metal continues at minimum pressure, and with the majority of the foundries only partially employed the outlook at present is far from reassuring. In Lancashire at present consumers are very indifferent to offers of cast scrap. Dealers usually quote 85s. per ton for good broken machinery castings delivered to consumer's works, but it is probable that the scrap could be bought on easier terms. In fact, the market looks like coming down soon to 80s. per ton. In the Scottish markets the demand for machinery cast-iron scrap is almost stagnant just now, and very little tonnage is changing hands. Foundries seem to have good supplies on hand, and, with pig-iron now reduced in price, their requirements in cast scrap are limited. First quality, however, is nominally 92s. 6d. to 93s. 6d. per ton; for ordinary cast iron, suitable for foundries and in pieces not exceeding 1 cwt., 85s. to 87s. 6d. per ton. Heavy cast iron in furnace sizes suitable for steelworks can be obtained at 82s. 6d. to 83s. 6d. per ton. Old cast-iron chairs have been reduced somewhat in price since the holidays, and fair parcels are being offered around 90s. and 92s. 6d. per ton. Supplies of this class are fairly good. Light cast-iron scrap is now offered at 75s. per ton, and if mixed with old c.i. firebars, 72s. 6d. per ton. The above prices are all per ton, delivered f.o.t. consumers' works.

Metals.

Copper.—Notwithstanding more favourable American advices, the market for standard copper has been by no means so responsive as expected in following the lead given by New York, and fluctuations in values during the week have been, on the whole, unimportant in extent. The successful conclusion of the London Conference, however, may be expected to have a reassuring effect.

Values are consequently steady.

Current quotations :—*Cash* : Thursday, £63 17s. 6d.; Friday, £63 15s.; Monday, £63 12s. 6d.; Tuesday, £63 7s. 6d.; Wednesday, £63.

Three months : Thursday, £64 17s. 6d.; Friday, £64 15s.; Monday, £64 12s. 6d.; Tuesday, £64 7s. 6d.; Wednesday, £64.

Tin.—Following the improvement in the international political situation, the market for standard tin is taking an optimistic view of the outlook, with an advancing tendency in values. Excellent American buying orders, together with covering operations, have contributed their quota to the recent advance, while good purchases were also effected in the East, where prices jumped at one time considerably ahead of London parity.

Current quotations :—*Cash:* Thursday, £253 15s.; Friday, £256 5s.; Monday, £255 15s.; Tuesday, £255 15s.; Wednesday, £258.

Three months : Thursday, £254 15s.; Friday, £257; Monday, £256 10s.; Tuesday, £256 15s.; Wednesday, £259.

Spelter.—The market for this metal continues fairly active, with values somewhat firmer generally. Although interest from galvanisers is not great, there is little doubt that the industry is busy, and more raw material is now going into consumption than has been the case for some time past. Current quotations: *Ordinary:* Thursday, £32 10s.; Friday, £32 13s. 9d.; Monday, £32 15s.; Tuesday, £32 12s. 6d.; Wednesday, £33 1s. 3d.

Lead.—Business in soft foreign pig has been adversely affected by the builders' strike, but so far there have been no sensational price developments. Reports of heavy supplies from Mexico are said to have been exaggerated. Current quotations :—*Soft foreign (prompt)* : Thursday, £33 2s. 6d.; Friday, £33; Monday, £33 2s. 6d.; Tuesday, £33; Wednesday, £32 18s.